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VOLUME 6 NUMBER 19
NOVEMBER 10, 1987

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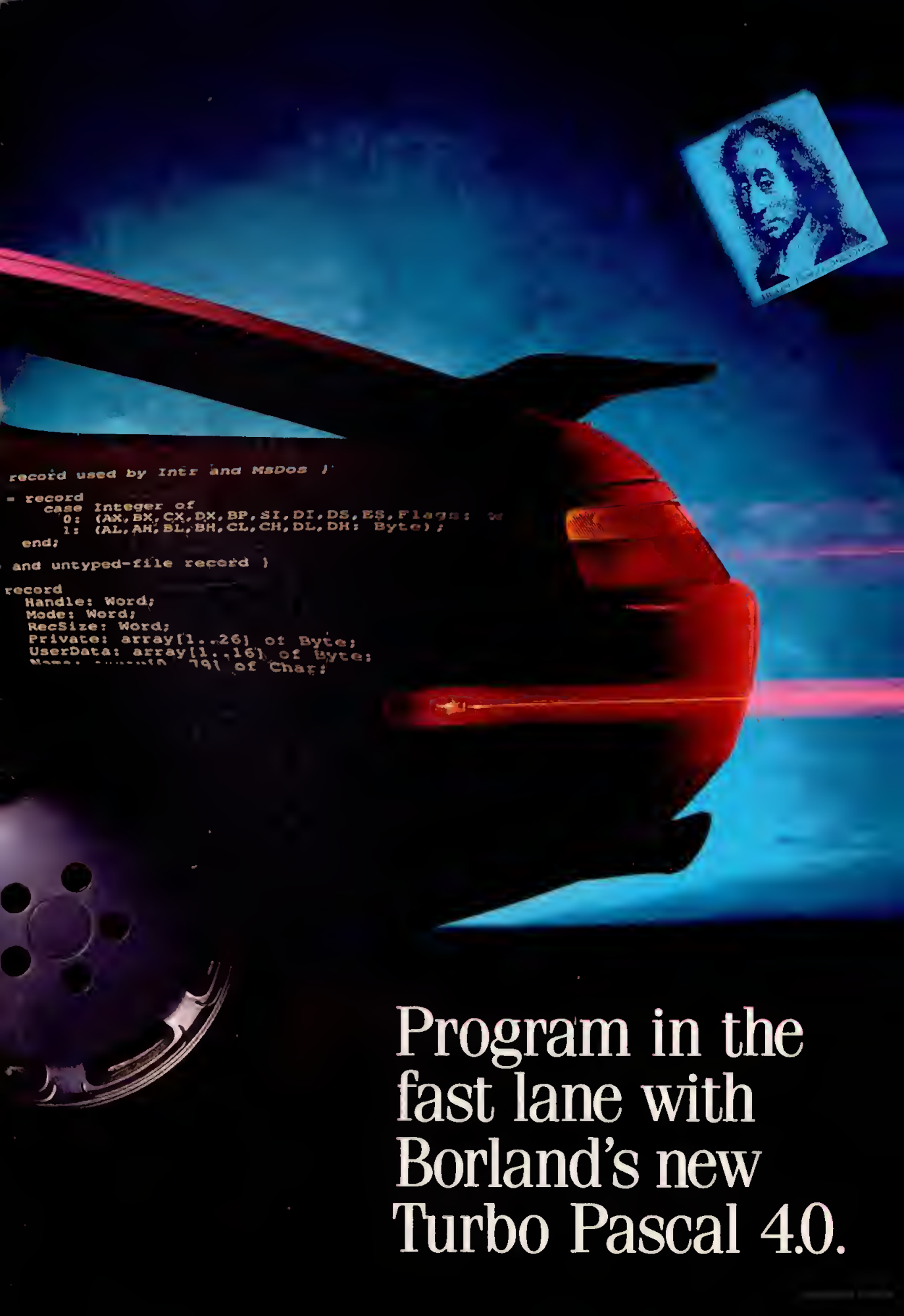
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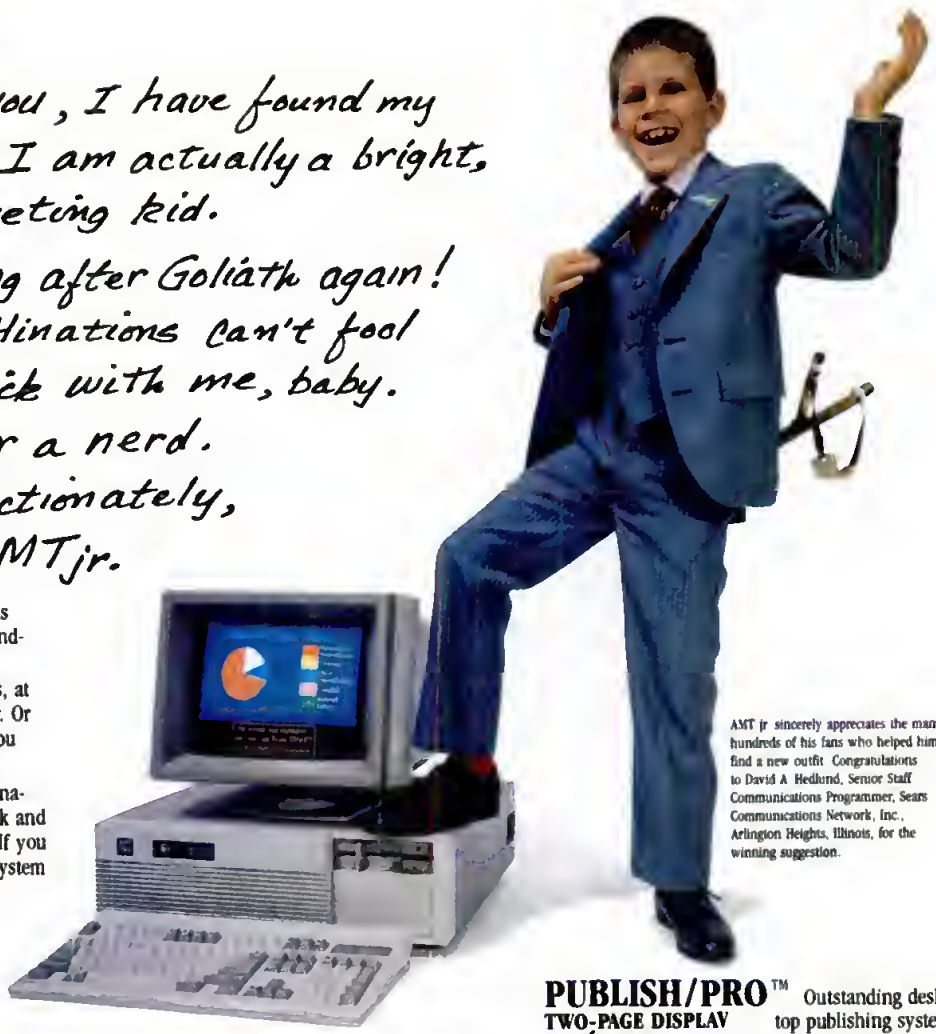
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WHAT'S INSIDE



Four down and counting: associate editor Robbin Juris headed this year's annual printer blockbuster issue.

As anyone familiar with the behind-the-scenes activity at *PC Magazine* knows, large-scale evaluation projects like our cover story are all in a day's—no, make that 3 months'—work. In fact, that's how long it took associate editor Robbin Juris (pictured here), PC Labs project leader Philip F. H. Rose, and 12 reviewers to plan and bring to completion this year's roundup of 106 new printers, a project that has justly earned legend status at *PC Magazine*—along with its share of epithets.

It might seem that with three printer projects and 287 printers already behind us, the fourth go and another 106 machines would be a piece of cake. Hardly. A good example of the kind of trivial problem—multiplied by 106—that can tie a project of this size up in knots is a vendor's tarrying until the final hour before deadline to deliver the goods. A case in point: the NEC Silentwriter LC-890, which turned out to be one of this year's Editor's Choices, seemed to take forever in the mail. Yes, even the printer industry is not without its share of ironies.

Call us zealots or just a bunch of overachievers, but even with reviews of 106 machines, a 23-page features table, and a historical index of printers past and present, we didn't have our fill of printers. In his sidebar entitled "The Problem with PostScript Emulation: Software, Not Hardware, Handshaking," PC Labs project leader and resident PostScript expert Bill O'Brien offers two methods of changing PostScript printers' handshaking protocol from software control to hardware control. And Dara Pearlman, a frequent contributor to *PC Magazine*, looks at 16 soft-font packages designed to help you get near-typeset-quality out of your Hewlett-Packard LaserJet.

Our cover story and related printer articles are not the only end products of a long-term undertaking to appear in this issue. For the past few months, Spreadsheet Clinic editor Jared Taylor has been using Microsoft's *Excel*—by far the most serious challenge to the *1-2-3* empire yet—which he reviews in First Looks. On the Macintosh, *Excel* has roundly whipped Lotus's *Jazz*. With new offerings from Surpass and PCSG, the spreadsheet market will undoubtedly be a free-for-all for the next few months.

Also in First Looks, editor Bill Machrone examines the first wave of the new 20-MHz 386 machines: Compaq's Deskpro 386 and Portable III. In a nice bit of portable one-upmanship, Compaq went straight from a 12-MHz 286 to a 20-MHz 386 chip without bothering with a 16-MHz 386 processor. PC

Photograph: Thom O'Connor

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PC MAGAZINE

COVER STORY

The 4th Annual All-Printer Review
Bill Howard/Since *PC Magazine*'s first annual printer issue in 1984, the printer market has seen substantial changes. Speed is up, prices are down, laser and 24-pin dot matrix printers are coming on strong, and daisy wheels are on the wane. Reflecting these changes are the 106 new laser, dot matrix, and daisy wheel machines reviewed in this year's roundup of printers. Following this discussion, you'll find the Printer Guide, a 23-page table that presents benchmark test results, along with text and graphics samples 92



Lasers: A New Standard
In 1984 the Hewlett-Packard LaserJet—the only laser printer we reviewed that year—set the standard for speed, print quality, and price. Three years later, *PC Magazine*'s roster contains 36 new laser (page) printers that fall into five categories, including at least two dozen machines that claim HP compatibility, have company-rated speeds of 6 to 8 pages per minute, and cost between $2,000 and $3,000. Hardly an uncanny coincidence, this flood of HP work-alikes suggests only one thing: today's office printer of choice is a fast, quiet $2,500 laser 152



Dot Matrix: The Jack-of-All-Printers
Still the largest of all printer categories, dot matrix machines continue to be the printers for the masses. The reason: While there may be nothing they're best at, there's hardly anything they can't do. Our reviewers take an extensive look at 65 of these generalists 246

Beyond Letter Quality
Dara Pearlman/If the most you expect from your HP LaserJet is letter quality, then you're probably not using soft fonts. *PC Magazine* examines 16 soft-font packages that can transform mere letter quality output into near-typeset quality 393



A Farewell to Daisy Wheels
Although low-end lasers and high-end dot matrix printers have made the $2,000 daisy wheel a thing of the past, a market still exists for daisy wheel printers in the $500-to-$1,000 range. *PC Magazine* reviews five Selectric-quality newcomers to this fast-narrowing group 378

Index to Printer Reviews
Out of the 393 printers PC Labs has tested over the past 4 years, 260 are still available. This index includes the most important details from reviews past and present 420

Cover Credits:
Typography design: David Herbick
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FIRST LOOKS

Hands On:

- Microsoft's *Excel* for the PC
- Two 20-MHz 386 PCs from Compaq: the new Deskpro 386/20 and the Portable 386
- Sharp's PC-4501 laptop
- *Microsoft Word* 4.0
- *Dac Easy Word II*
- Polaris's *Zoo Keeper*
- Zenith's ZCM-1490 flat-screen monitor
- *Show Partner F/X*
- *dBASE III Plus: Tips, Tricks and Traps* by Dr. George Tsu-der Chou
- Two add-in memory boards for the PS/2 Micro Channel from AST Research and Quadram Corp. 33

AFTER HOURS

Hands On:

- *Business Week*'s *Business Advantage*
- *Where in the World Is Carmen Sandiego?* and *Where in the USA Is Carmen Sandiego?*
- *Tinbox2*, a home-inventory database
- Gessler Publishing's *Batalla de Palabras* and *La Guillotine*
- Drake Beam Morin's *Career Navigator*
- Matchups' *Tyler* word game 612

PRODUCTIVITY

PC LAB NOTES
Internal Error Handling in PC-DOS
Robert L. Hummel/DOS's Critical Error Handler doesn't give you many options or much help in identifying what the problem is. But SAFARI, the TSR we include here, will 435

UTILITIES
Getting Control of Your Cursor
Jeff Prosise/CTYPE sculpts your cursor's shape the way you like it—fat or skinny, tall or short. It also puts the cursor back on-screen if exiting a program wiped it out 463

ENVIRONMENTS
OS/2 Kernel Programming
Charles Petzold/No one writes to the Kernel until they find out how easy it is to convert old DOS programs to work in this new environment 483

SPREADSHEET CLINIC
Jared Taylor/Getting back to where you once belonged after leaving the current cell; *1-2-3* talks back, telling you when it's loaded or if it's busy; a *SuperCalc* command that will leave you in suspense 495

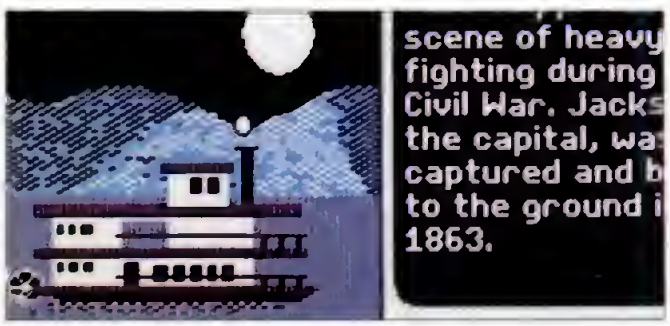
USER-TO-USER
Paul Somerson/Disabling Ctrl-Alt-Del so there will be no escape; byte, sector, and cluster ratios and totals for the selected drive; temporary PATH changes 501

POWER USER
Craig L. Stark/Loading *Microsoft Word* while you tell it where to go; separate macro libraries lend more macros to *WordPerfect*; improving *SideKick*'s cut-and-paste and *dBASE*'s PgDn 509

LANGUAGES
Robert L. Hummel/Turbo Pascal I/O redirection demo; a stuffer for the keyboard buffer that executes other programs after a Turbo Pascal program ends; BASIC banner builder; easy number rounding for your BASIC programs 519

PC TUTOR
Robert L. Hummel/An icon that winks at you when your disk is accessed; a key substitution utility to make your keyboard into anything you want; the source for tech info books that's a phone call away 527

CONNECTIVITY CLINIC
Frank J. Derfler, Jr./What IBM means by its CUT and DFT; whether to buy new software for new LANs; when file transfer speed makes a difference 537



VIEWPOINTS

LETTERS TO PC MAGAZINE 17

PC ADVISOR
Mitt Jones/Backing up your hard disk with a VCR, and recovering data from an overwritten database file 27

FROM THE EDITOR'S SCREEN
Bill Machrone/Less Choice, More Freedom 65

JOHN C. DVORAK
Marketing, Marketing, Marketing 71
Inside Track 73

JIM SEYMOUR
Better User Interfaces 77

STEPHEN MANES
The Upgrade Road: Curves Ahead! 85



PC Magazine Help
File 433
Direct Marketing
Connection 543
Reader Service Card .. 563
Marketplace 567
Advertisers' Product
Index 602
Editorial Product
Index 604
Coming Up 604
Index to Advertisers ... 605

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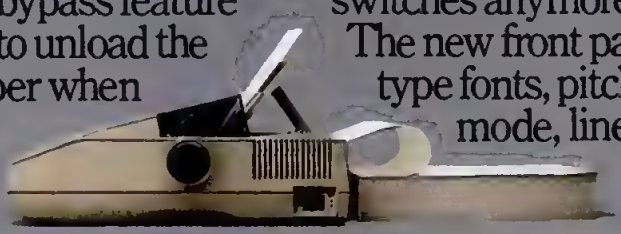
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es Child's Play Paper Route.

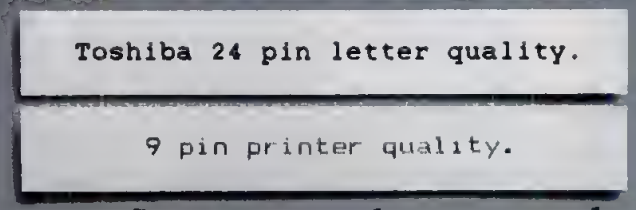
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Numbers speak

Leading Word Processors	Cursor to end of document (a)
Microsoft Word 4.0	0.2
WordPerfect™ 4.2	2.2
DisplayWrite™4 1.0	5.1
MultiMate Advantage™ II 1.0	0.2

Tests were performed on a Compaq Deskpro 286 (8 MHz), 640K RAM and an EGA graphics adaptor. a = 9 page document, b =

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*The evaluation version of Microsoft Word 4.0 is limited only by the size of the file you can create. It does not include the spellchecker or thesaurus available in the full version of Word 4.0.

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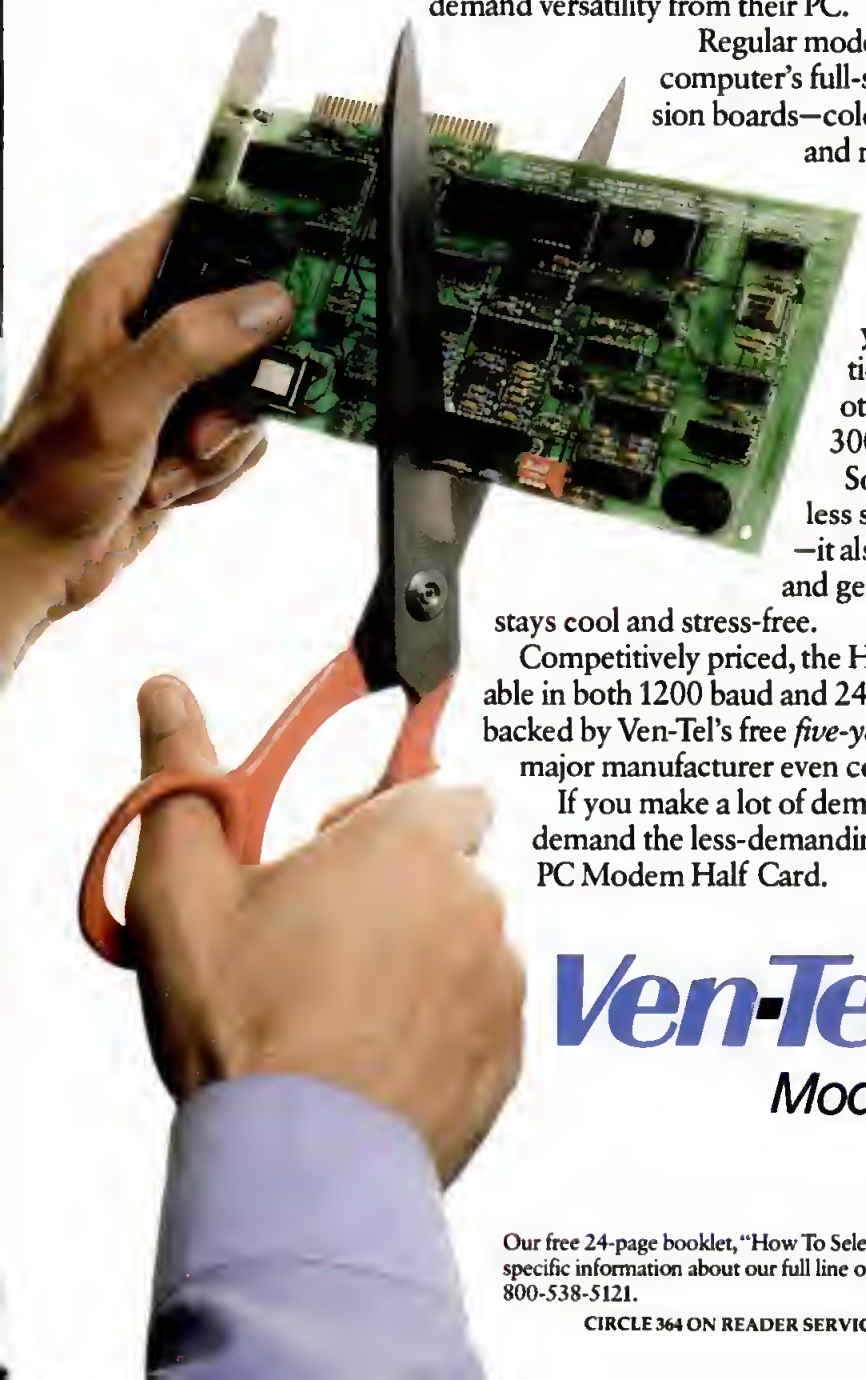
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Scroll by line (b)	Search + replace (c)	Delete 100 characters
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38.5	6.0	10.7
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CIRCLE 364 ON READER SERVICE CARD

LETTERS TO PC MAGAZINE



ENDLESS EXECUTION

I believe I have spotted a potential problem with a macro in the article "Beyond Number Crunching" (*PC Magazine*, Volume 6 Number 13). In Figure 5, the database query macro repeatedly executes by calling itself with a subroutine call. The problem is that *1-2-3* can store only 32 layers of subroutines before the error message "Too many nesting levels in macro calls" appears. This will occur if more than 32 database queries are made. However, the macro could execute endlessly if the last line of the macro was {branch Get_data} ".



Gerald Puscas
Birmingham, Michigan

This is a quick-and-dirty macro that was never intended to run indefinitely, but good coding practices dictate that we cover all bases whenever possible. Thanks for the suggestion.—Tom Badgett

SPEED WAS THE ISSUE

In his review of the Kaypro 386 and PC's Limited 386-16 (First Looks, page 33, *PC Magazine*, Volume 6 Number 14), Winn L. Rosch states that "to earn the respect of the marketplace [a computer must be] based on Intel's 80386 microprocessor, offering fast processing all the way through."

Recommending a computer based solely on speed is like recommending a Porsche 935 to someone shopping for a family car. The fact that most dealers cannot service it, that it is not compatible with standard auto fuel, or that it costs $100,000 does not matter. What they tell you is important is that "it flies!"

What happened to issues like compatibility or dealer support?

David Emmi
Syracuse, New York

The review of the Kaypro and PC's Limited 386-16 was not a feature review, but a "first look" that was meant to accent a new product and what makes it important. In this case, the news concerned the 80386 microprocessor and how it has been put to use. Later reviews in PC Magazine *will cover all the features of these machines.*

Note, however, that when you go out looking for a Porsche, you're going to be more concerned with performance than room for a family. If you look at an 80386-based computer, you're similarly going to focus on performance.—Winn L. Rosch

A REQUEST FOR TERMS

Since I am a recent subscriber to *PC Magazine*, your articles often use terms that I am not yet familiar with. Because I am sure other readers share this problem, may I suggest that you publish a glossary of PC terms several times a year?

Larry Gabbey
Racine, Wisconsin

Feature reviews that cover new technologies often include glossaries. We don't run Beginners' Basics glossaries because most people are rank beginners for only a few weeks; magazines that cater to novices usually don't last very long.

Consider joining a user group—most user groups have sections for novices. Or curl up with a good book. See "Technical Support as Handy as Your Bookshelf," PC Magazine, *Volume 6 Number 10, for reviews of the 19 best computer books on DOS, PCs, and the most popular software.*—Bill Howard

VDISK.SYS LIVES

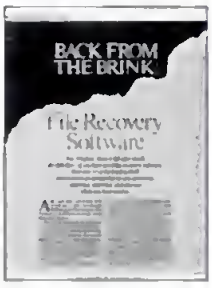
Contrary to your report in "DOS Lives" (*PC Magazine*, Volume 6 Number 13), VDISK.SYS is alive and well in the latest version of DOS.

Jay W. Luther
San Francisco, California

What IBM removed from DOS 3.3 (and put in slightly different form in its DOS Technical Reference*) was the "assembly language" listing for VDISK.SYS, rather than the VDISK device driver itself. But it also similarly banished LINK and EXE-2BIN and replaced all documentation in the 3.3 DOS manual on DEBUG with some inscrutable mumbo jumbo about code page switching.*—Paul Somerson

READER BEWARE

In regards to Winn L. Rosch's article on recovery utilities ("Back from the Brink: File Recovery Software," *PC Magazine*, Volume 6 Number 14): While running the *Mace Utilities* Condense program, an unexpected power-down or premature exit from the program may result in the destruction of all or part of the information on a disk.



Since a 30-megabyte disk can take upwards of 45 minutes to condense, the time of exposure is great while the benefits aren't really very noticeable. So before

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PC-11/10/87

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- ☐ **EDUCATION 3**—PC-Fastype 1.20 typing tutor, ideal for beginners and advanced students alike.
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CIRCLE 302 ON READER SERVICE CARD

■ LETTERS

you try Condense on a hard disk, you should definitely back up everything and double-check your backups first.

John Bales
Gaithersburg, Maryland

Your warning is well heeded, but this danger is not exclusive to Mace. *Any time you're tinkering with the FAT of your hard disk, your system is prone to disaster when the power fails. Although some software tries to minimize the damage, there are always pieces left to put together after the worst does happen.*—Winn L. Rosch

WORDPERFECT'S LIBRARY OPTION

What Merv Adrian didn't tell about *WordPerfect Library* in his review is that its architecture ties up available RAM that it is not using and denies it to *WordPerfect* ("TSR Desktop Organizers: More Features, Fewer Conflicts," *PC Magazine*, Volume 6 Number 14). This defect forces the word processor to create overflow files even for short documents and makes it impractical to use *WordPerfect* in its fast-working resident mode.


TSR DESKTOP ORGANIZERS
MORE FEATURES, FEWER CONFLICTS

By constantly forcing *WordPerfect* to go to disk for the simplest operations, *Library* puts unnecessary wear and tear on the disk drive while large amounts of RAM remain idle. My conclusion is that a shell that cripples its own parent utility is a poor Editor's Choice for *PC Magazine*.

Daniel H. Garrison
Evanston, Illinois

We find that the default document buffer of 10K bytes coupled with the default file-caching area of 20K is more than adequate for small documents. However, Library *will allow* WordPerfect *to occupy all available RAM if you specify the /W option under Shell's setup menu for* WordPerfect.—Ed.

PRODUCTIVITY VIEWS

The Productivity section of *PC Magazine* is the most informative and interesting section of any computer magazine I regularly read. The code is good, the programs are almost always useful, and the accompanying articles are informative and concise.

Peter A. Westcott
La Mirada, California

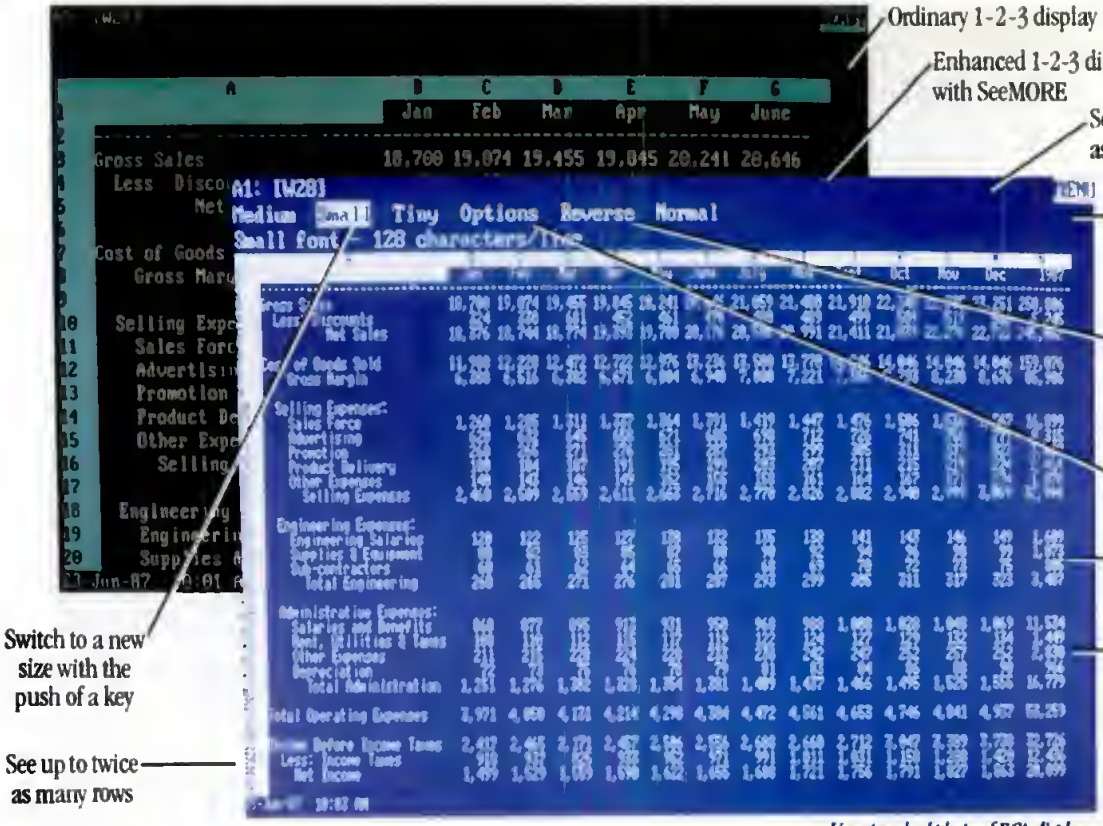
Partly in response to letters like this, we've expanded our Productivity coverage by adding back-of-the-book columns on languages and OS/2 and are about to start a new column on bare-metal C and .ASM systems programming. We've also added 16 more lines to our PC-IRS bulletin board on the West Coast, which should bring the number of daily downloads up to about 20,000. Dial us up at (415) 598-9100 (2,400/1,200/300 bits per second, 8 data bits, no parity, 1 stop bit) to download the free programs, documentation, and actual .ASM listings.—Ed.

Mr. Prosise and Mr. Hummel, two of your supposed PC-DOS "experts," should spend more time learning about PC/MS-DOS and programming before telling others how to write "nifty" internal utilities (PC Lab Notes, *PC Magazine*, Volume 6 Number 14). Both these gentlemen use a memory paragraph-by-paragraph loop-and-search method to "find" DOS memory control blocks. Besides being archaic, this is the fool's way of doing something. It's like saying your car has cruise control—a brick on the gas pedal.

In addition, after a long discussion about memory control blocks and their use, they never mention that a program can and should free its environment segment if the program is resident and does not need it. DOS can and does use the fragmented memory blocks for environment segments for other programs that are to be executed.

Alan J. Chwick
Freeport, New York

The memory control block technique is necessary because it's the only real way to be compatible with every version of DOS on the market; other methods stumble over nonstandard configurations. In any event, the articles in question dealt with DOS's control of memory, not programming techniques for conserving memory. And a number of other readers who took the time to read the published source code of such utilities as SLASHBAR and SPECTRUM

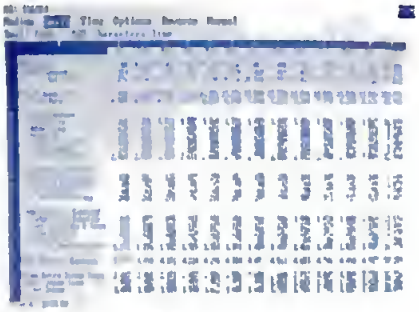


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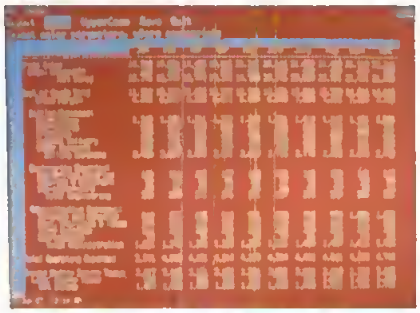
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CIRCLE 470 ON READER SERVICE CARD

■ LETTERS

were in fact treated to lessons on freeing memory such as the ones Mr. Chwick missed.—Ed.

QUOTE UNQUOTE

In your July 21, 1987, issue, Bill Machrone attributed to John Donne the saying "We see now as through a glasse darkly" (From the Editor's Screen, *PC Magazine*, Volume 6 Number 13). Perhaps Donne did say that, but if he did, he was quoting St. Paul from 1 Corinthians 13:12. The "glasse" does not refer to a transparent medium as we know it, but to a mirror made of polished brass that reflected a dingy and fuzzy image. Paul used it figuratively to describe the Old Testament's confusing sayings. (It might also appropriately describe IBM's new color monitors, although I doubt it.)

C. Leo Jordan
Elizabethtown, Kentucky

An Elizabethan such as yourself should have recognized the most influential and well-remembered sermon given in the 17th century. Donne based his text on Paul's letter.—Ed.

TAKE NO OFFENSE

I agree that the NEC APC IV is not an exciting innovation that stirs the blood of a sophisticated hobbyist ("NEC APC IVs: Copycat Engineering at Its Best," *PC Magazine*, Volume 6 Number 14). However, Winn L. Rosch's clichéd and stereotyped labeling about Japanese copycat engineering on page 304 is clearly a generalization about an entire nation rather than a comment about a single manufacturer.



Although I am an American citizen, I take pride in my ethnic heritage and find the attack extremely offensive.

Yoe Itokawa
Birmingham, Alabama

I am sorry you took offense, but the comment was not racially motivated. I've cited copycat engineering in products made everywhere from Taiwan to Texas. I acknowledge the many innovations the Japanese engineers have made, but alas, the NEC APCs do not demonstrate any of them.—Winn L. Rosch

PROGRAMMER PRAISE

The description of the Oregon pines and the Pacific coastline visible from Michael J. Mefford's office is appealing (What's Inside, *PC Magazine*, Volume 6 Number 14), but it doesn't sound as though he has any time to enjoy it. I would like to see Mr. Mefford's work for many issues to come, but please give him a raise and tell him to ease up and try working 14 hours per day, 6 days a week instead.

Also, the articles on the WIN Labs 386 computer and EXE2COM.EXE from The Cove Software Group were real gems (First Looks, page 34 and 46, *PC Magazine*, Volume 6 Number 14). I look forward to the next issue to see what other treasures await me.

Robert J. Spear
Accokeek, Maryland

Thank you for Michael J. Mefford's DR.COM (Programming/Utilities, *PC Magazine*, Volume 6 Number 14). "Our Best Free Utility Ever"—hear, hear! Keep up the good work.

Bob Stoeckle
Midway, Pennsylvania

CORRECTIONS/AMPLIFICATIONS

Eric Isaacson Software's *A86* macro assembler claims to assemble at 1,000 lines per *second*, not per minute as was reported (First Looks, page 48, *PC Magazine*, Volume 6 Number 14).

HOW TO WRITE TO PC MAGAZINE

Do you have a comment, compliment, or criticism about something you've read in *PC Magazine*? A question you'd like to open up to other readers? Then send your opinion to Letters to PC Magazine, One Park Avenue, New York, NY 10016, or through MCI Mail to PCMAGAZINE.

All letters become the property of *PC Magazine* and are subject to editing. We cannot publish letters that do not include a name, address, and phone number for verification. We're sorry we're not able to answer letters personally.

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"...and where to get good information about that software? The answer is easy on both counts: it's the Public (Software) Library.

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– Steve Cummings, August, 1987
Computer Currents Magazine

Most experts already know that the PsL is the best library of public domain and shareware software available because we care strongly that the PsL should be the best we can make it.

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292-PC-DeskTeam - calc., calendar, etc.
487-Automenu - DOS menu program
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10 BIG REASONS IT'S TIME YOU CHANGED YOUR EDITOR TO BRIEF

1 FUNDAMENTAL TRUTH. If you are a programmer, you use your editor more than any other tool. If it isn't the best, the fastest, the most versatile, the most productive... well, then neither are you!

2 OUR ENTHUSIASM. While we do not publish BRIEF we wish we did. We sell so many BRIEFs that we've been advertising it non-stop since it was introduced two years ago. We're not alone in our enthusiasm. There is no end of accolades from other admirers.

BRIEF Encounters

"The word is getting around... that BRIEF... is simply the best text editor you can buy." John Dvorak in *Infoworld*

"In the last five years, only a handful of applications have altered the way we use microcomputers. The winners... impact is astounding. BRIEF is a winner that will most definitely change the way we develop application software." *Data Based Advisor*

"Overall, BRIEF is an excellent and efficient editor with capabilities that are truly useful. If you're a serious programmer or developer of commercial applications, the BRIEF/dBRIEF package is one of the best investments you can make." *PC Magazine*, 7/86

"Every time I've mentioned text editors I've got a raft of mail urging me to try Brief. Now that I've tried it I see why. It has windows—boy, does it ever have windows! It will do just about anything you want it to... look no further... recommended." Jerry Pournelle, *Byte* 12/86

Best editor of 10 compared
Dr. Dobb's Software Tools

3 WINDOWS ON THE WORLD. Why the excitement? First, BRIEF's architecture. *Any number of files* of virtually any length can be open. (Start BRIEF with "*.*" to prove it.) Open as many tiled windows as fit the screen—over/under and side-by-side—to work on any of your files. Open, close, and resize windows as you go. In each window, full screen or tiny, all editing techniques are at hand—high-speed cursoring, paging up and down, horizontal scrolling, optional word wrap. Load the same file in any number of windows to view different areas simultaneously. A change in one changes all. Cut and paste text blocks between windows and files, or into buffers for later recall. All files stay in memory, so you can always go back to snip some more.

4 WHOLLY MACROS. Much of BRIEF was written in its own macro language. It is that powerful! The language and its compiler come with every copy, as do many standard macros, with source code for learning by example. It is a complete language with conditionals, loops, recursion, global and local variables, even data types. It can control files, windows, and the keyboard. It has structure, 32-character variable names, and—not at all like 1-2-3*'s cuneiform—is entirely readable, like a hybrid of LISP and C. With it you can develop a library of routines to power BRIEF your way.



5 UNDO. NOT UN-DELETE. Don't confuse the two. BRIEF doesn't just keep snapshots of recent deletions should you want to pick them up from the cutting room floor. It can reel the whole film backward undoing any command that affected the cursor or the text. Watch it undo a global replace, for example. Uncanny. It can back up 300 times, all the way to the beginning of a session. "Works like a dream", said *The C Journal*.

6 SHELL GAMES. Leave BRIEF, run your compiler, print out the error messages, load up BRIEF again? No way! Run your compiler from *inside* BRIEF*. It will point to each error line in your source program, still loaded in memory, for immediate editing. You don't have to leave BRIEF to use DOS either. BRIEF disappears from the screen to get out of your way, but say bye to DOS and BRIEF pops back to the screen, as do all the files you were working on.

7 KEY WHIZ. You can reassign BRIEF's command keyhits to whatever keys you're used to, even your old editor's, so you don't have to send your fingers back to school. Macro execution can be assigned to single keys. Or you can tell BRIEF to listen while you tap out a complex routine. It will save and playback faithfully, a shortcut macro without a single line of coding.

8 MULTI-LINGUAL. BRIEF's macro language is perfect for writing formatters for your language which indent, match up parentheses and brackets, and set up statement templates for fill-in. BRIEF comes with C language support already built in. Others have written macros to format Pascal, BASIC, LISP, Prolog, FORTRAN.

9 QUICKER PICKER-UPPER. Looking for something? BRIEF has full UNIX*-like expression search tools to forage and find and fix any file in memory. Literal strings with wildcards and "?" character masking, sure. But also indifference to case or intervening characters, [aeiou] to match all vowels, or [~aeiou] to match anything *but* vowels, [a-f,l-m] to match character ranges, beginning or end of line searches, even multiple choice pattern matching and replacement.

10 REASONS 11 THROUGH 20: **11.** BRIEF comes with a color option. You can select your own color scheme anytime. **12.** It supports EGA's 43-line mode and can display up to 128 lines long. **13.** Full 8-bit ASCII display, the whole character set can show on screen. **14.** Full path support. **15.** Command line start-up flags to modify BRIEF's behavior, change a path name, or run a macro: for example "wp" which turns BRIEF into a word processor with wraparound and margin setting. **16.** Automatic file save during idle moments. **17.** Compatibility with most stay-resident programs (like Sidekick™), multi-taskers (like Microsoft Windows™), and networks. **18.** A bulletin board with public domain macros contributed by a mushrooming cult of macromancers. **19.** No copy protection. **20.** Context sensitive help, and phone support from the publisher.

dBRIEF. The Power Environment for dBASE Programming

Many worthy utility products supply needs that dBASE®'s programming language doesn't—dUTIL™, dFLOW™ and a host of others. Trouble is, you have to use them separately, then combine their output into your dBASE program files.

No longer. dBRIEF™ written in BRIEF's macro language, grabs hold of BRIEF and turns it into a complete dBASE III and III Plus programming domain. Using BRIEF's underlying shell capabilities and its own interfaces, dBRIEF can run external utility libraries, plus dBASE itself, and link to the Clipper™, Foxbase+™ and Quicksilver compilers, all with dBRIEF still loaded and running the show. It can do what BRIEF already does, plus:

- Convert a screen layout into dBASE code for interactive data entry
- Display dBASE file structures in windows, a great convenience alongside your program files
- Expand keystrokes into full dBASE statements
- Indent automatically for elegic display
- Create databases, index files, invoke Ashton-Tate's dFORMAT™ and dCONVERT™, draw lines and boxes

"Simply marvelous programming environment for writing and editing dBASE programs", *PC Magazine*, 7/86. Source code included!

Requires BRIEF 1.32 or later and 384k. 512k to run dBASE within dBRIEF. 640k and harddisk recommended.

* Brief needs 192k normally, 320k for compile feature. •Product must be returned in resalable condition.

NEW VERSION 2.0!

*Support for more languages • Regular expressions match over multiple lines • Faster undo & expression search • Added types of block marking • Optional borderless windows • Supports displays with 127 lines, 255 chars • New documentation with tutorials on regular expressions and macros • **30 DAY** money-back guarantee for products in resalable condition.*

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List Prices: BRIEF: $195. dBRIEF: $95
BRIEF/dBRIEF Combination: $275.

PC BRAND Prices: CALL

PC BRAND PRESENTS RYAN-McFARLAND

FORTRAN WITH ENVIRONMENTAL IMPACT

NEW VERSION 2.4



A complete implementation of Fortran-77 (ANSI X3.9-1978), RM/FORTRAN was the first certified by the General Services Administration at the highest test level. The reason: it's a big mainframe compiler moved to PC's, with the bonus that mainframe and mini applications can wander between environments. What really sets RM/FORTRAN apart is the new RM/Forte project manager, a free bonus with version 2.4

Now on your PC, you can develop large applications with programs up to 640k (bigger using overlays), arrays over 64k, and using a long list of VS, VAX and FORTRAN-66 extensions you may have grown fond of. Two years of successful conversions from mainframes by thousands of engineers and scientists prove that RM has it all.

Optimization reduces instructions to the minimum that will execute, even takes advantage of each processor's features to deliver lightning-fast object code. So there's scant reason left to queue up for the mainframe. Do development work fast on a PC and move the job after completion. Or move jobs off the mainframe or mini and switch for good.

Version 2.4 has "implicit none" to suspend default variable typing, complex 16, a Plink86 subset, a cross-reference compile option, IEEE floating point, 8087, 80287 and 80387 co-processor support, and inter-language calls in either direction between FORTRAN and C modules.

Austec's Ryan-McFarland has been writing FORTRAN compilers for IBM, DEC, etc. for 20 years, including IBM PC Professional FORTRAN and the new FORTRAN/2. So if FORTRAN's superiority for scientific and engineering applications is your need, there is no greater expert.

List **$595** PC Brand: **$499**

RM/Forte Wraps an Environment Around FORTRAN

Ryan-McFarland has developed a comprehensive environmental shell to manage any number of FORTRAN projects. It has its own feature-packed editor, a split-screen debugger that toggles between source and program output, and a "make" which remembers your compile and link scripts. No more batch files. In fact, put your application in RM/Forte's windows and show DOS the door.

Select an application and RM/Forte's screen shows all its files. Point at one and choose any function in a bottom-screen menu: edit, compile, link, list, check syntax, whatever. Pop-up help and programmable function keys move you instantly between chores.

RM/Forte™ keeps status records of every file, when each was last compiled, error and warning counts, which modified files need re-compiling, even what needs doing next.

The cost? It is absolutely free with the new RM/FORTRAN v2.4.

COBOL WITH A DOUBLE STANDARD

OVER 500,000 INSTALLATIONS

If you want double or nothing, Austec's RM/COBOL-85 rolls both the 74 and 85 standards into a single compiler. It can compile your present applications without change, do it twice as speedily, store data in as little as a fifth the space, and run those programs up to eight times faster than earlier RM/COBOL's!

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RM/COBOL-85 is designed for machine-independence. Develop on your PC with the confidence that your application can get along anywhere in the DOS, XENIX and UNIX worlds. Moreover, the RM/COBOL family expands to DOS networks and multi-user setups under UNIX™ and XENIX™. This is software from professionals.



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SUPER SOURCE

Aldebaran's Source Print

Author Alan Simpson writes "the best overall debugging technique is to draw lines to connect all the IF and DO WHILEs etc with their ENDIFs and ENDDOs. Then use a pencil to"—Well, thanks, Alan, but we'll use Source Print instead. It draws those vertical lines to connect the beginnings and endings of structure in a vivid display of your program's organization. It can print your programs with page numbers, headings, line numbers, indent automatically, throw in a table of contents and cross-reference index. "Occasionally a utility comes along that makes a programmer's life much easier. Source Print is such a program" says *PC Magazine*. List **$75, Ours: $60.**

...add Tree Diagrammer

Tree Diagrammer prints an organization chart of your program's structure showing the hierarchy of function, procedure and subroutine calls. Shows at a glance what routines call each other for clearer debugging. Every shop should have this important documentation tool. List **$55**. Ours **$45.**

C-TREE & R-TREE

B-Tree File Manager Now Has Report Generator

c-tree: The only major b-tree file manager with network support in the standard low cost version, c-tree™ gives you record-locking routines for DOS 3.1/3.2, UNIX and XENIX, and it even comes in C source code, yet there are no royalties. Source sticks to K&R, so C-tree is portable. Tests in many environments prove it.

Permits any number of keys for a data file—alpha, numeric, even floating point. Handles files with varied record lengths, multiple keys in one index file. Both high level and decomposed functions. It's the works.

r-tree: Adds the ability to produce ad hoc reports from files maintained by c-tree (v. 4.1 and up). Link a file description to the r-tree™ library, and use any text editor to write report scripts with no further C coding. Reports can access data in several files, select on criteria, join findings into new logical records, sort them, calculate new fields and columns, tabulate by control breaks. Comes in source; same portability as c-tree, and fits any compiler.

	List	Ours	Combined
c-tree	**$395**	**$329**	**$541**
r-tree	**$295**	**$245**	

WINDOWS for DATA

FIRST PRIZE!

M'Soft Windows Compatible

"Only one package can be easily recommended" said *Computer Language* (June '87) reviewing nine window and data entry products for C. Complete field level functions specify prompt string, field length, data type, screen location, picture, target variable, entry rules, help messages, even functions to call for validation once data keyed in.

Windows for C is a subset. No data entry but all windowing functions. Unlimited windows can be made either to pop up or permanently overwrite the screen, scroll and highlight lists vertically and horizontally. Specify Compiler. Windows for Data. List **$395,** Ours **$315.** Windows for C. List **$245,** Here **$216.**

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C Utility Library	**$185**	**$119**
Essential Graphics	**$250**	**$183**
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Shopping List for the Power Workbench

	LIST	US
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PROLOG Compiler & Interpreter	650	569
Screen Design Toolkit	50	44
SQL Development Package	295	229
Arity PROLOG Interpreter	295	229
Arity Standard Prolog	95	77
AI-EXPERT SYSTEMS		
Autointelligence *by IntelligenceWare*	990	739
Expertise-It *by IntelligenceWare*	475	339
EXSYS *Development Software by EXSYS*	395	309
EXSYS Runtime System	600	469
Insight 2+ *by Level Five Research*	485	379
Intelligence/Compiler *IntelligenceWare*	990	739
AI-LISP LANGUAGE		
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IQLISP *by Integral Quality*	270	Call
Microsoft LISP *Common LISP*	250	199
TransLISP *from Solution Systems*	95	Call
TransLISP PLUS *from Solution Systems*	195	Call
AI-PROLOG LANGUAGE		
APT *Active Prolog Tutor from Solution Sys*	65	Call
MPROLOG Language Primer *LOGICWARE*	50	45
MPROLOG P500 *by LOGICWARE*	495	395
MPROLOG P550 *by LOGICWARE*	220	175
Prolog-86 *from Solution Systems*	125	Call
Prolog-86 Plus *from Solution Systems*	250	Call
Turbo PROLOG *by Borland Int'l*	100	83
Turbo PROLOG Toolbox *by Borland Int'l.*	100	84
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Advanced Trace-86 *Morgan Debugger*	175	119
C-Sprite Debugger *by Lattice, source level*	175	139
Microsoft Macro Assembler *with Utilities*	150	109
PASM86 *by Phoenix, Macro Assembler*	195	139
Periscope I Debugger *The Periscope Co*	345	299
Periscope II *with NMI Breakout Switch*	175	139
Periscope II-X *software only*	145	105
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Microsoft BASIC Interpreter *for XENIX*	350	295
Microsoft QuickBASIC Compiler. *3.0*	99	79
BORLAND PRODUCTS		
Reflex & Reflex Workshop	200	129
Reflex *Data Base System*	150	99
Reflex Workshop	70	45
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Turbo C Compiler *New*	100	84
Turbo Lightning	100	84
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Turbo PROLOG Toolbox	100	84
Turbo Tutor	40	28
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C86 PLUS *by Computer Innovations. New*	497	397
Lattice C Compiler *from Lattice*	500	299
Let's C Compiler *by Mark Williams*	75	55
with CSD Source Level Debugger	125	90
MWC-86: Mark Williams C Development	495	369
Microsoft C Compiler *4.0*	450	295
Turbo C Compiler *by Borland. New*	100	84
C INTERPRETERS		
C-Terp *by Gimpel Software*	300	249
Instant C *by Rational Systems*	500	395
Interactive-C *by IMPACC with debugging*	249	219
RUN/C Professional *from Lifeboat*	250	185
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Asynch Manager *by Blaise, for C or Pascal*	175	135
Greenleaf Communications *by Greenleaf*	185	139
C UTILITY LIBRARIES		
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Blaise Turbo C TOOLS	129	99
Blaise C TOOLS PLUS	175	135
C Food Smorgasbord *by Lattice*	150	109
C Utility Library *by Essential, 300 functions*	185	119
Greenleaf Functions *by Greenleaf Software*	185	139
COBOL LANGUAGE		
RM/COBOL *see Ryan-McFarland Prod*		
Microsoft COBOL Compiler	700	499
Microsoft COBOL Compiler *for XENIX*	995	795
Micro Focus COBOL *see Micro Focus Prod*		
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BRIEF/dBRIEF *Brief for DBASE III*	275	Call
CLIPPER *from Nantucket*	695	375
McMAX. *dBASE for MAC from Nantucket*	295	Call
dBx. *dBASE to C Translator by DESKTOP AI*	350	299
with Library Source Code	550	469
with Full Source Code	1500	1292
dBC *from Lattice, maintains DBASE files*	250	195
with source	500	390
dBC III Plus. *supports multi-user DBASE*	750	595
with source	1500	1185
DEVELOPMENT TOOLS		
BASTOC *by JMI, convert BASIC to C*	495	399
BASIC-C *BASIC's functions added to C*	175	139
Report Option *Softcraft Btrieve Report Gen*	145	128
Xtrieve *Softcraft Query Utility for Btrieve*	245	220
Code Sifter *Profiler by David Smith*	119	89
Dan Bricklin's Demo Program *Prototyper*	75	99
LMK *from Lattice, "make" like UNIX*	195	149
Microsoft Window Development Toolkit	500	395
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C Utility Library	185	119
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Essential Comm Library	185	125
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Btrieve Network *by Softcraft*	595	465
C-Tree *by FairCom - no royalties, source*	395	329
R-Tree *by FairCom-Report Generator*	295	245
C-Tree & R-Tree Combo *by FairCom*	650	541
dbVista *single user DBMS by Raima*	195	139
dbVista *multi-user DBMS*	495	399
Opt-Tech Sort *Can sort Btrieve files*	149	105
FORTRAN LANGUAGE		
RM/FORTRAN *by Ryan McFarland*	595	499
FORTRAN Libraries. *by Alpha Computer*	70	45
Microsoft FORTRAN *Links w/Microsoft C*	450	281
Microsoft FORTRAN *for XENIX*	695	546
Scientific Subroutine Package *by Alpha*	295	239
GRAPHICS		
Essential Graphics *Essential, no royalties*	250	183
GSS Graphics Development Toolkit	495	375
GSS Kernel System *by Graphic Software*	495	375
GSS Metafile Interpreter	295	239
Halo *by Media Cybernetics*	300	219
with Dr. Halo II	440	299
Halo for Microsoft *includes all fonts*	595	434
MICRO FOCUS PRODUCTS		
Micro Focus Level II COBOL *w/Animator*	495	395
Level II COBOL	349	279
Level II Animator	195	155
Micro Focus Personal COBOL	149	99
Forms-2	295	235
MODULA-2 LANGUAGE		
MODULA-2 Apprentice Pkg *by LOGITECH*	99	79
MODULA-2 Magic Pkg *by LOGITECH*	99	79
MODULA-2 ROM Pkg & Cross RT Debugger	299	239
MODULA-2 Window Pkg *by LOGITECH*	49	39
MODULA-2 Wizard'e Pkg *by LOGITECH*	199	159
OTHER LANGUAGES & UTILITIES		
Source Print. *source code formetter*	75	60
Tree Diagrammer *source code diagrammer*	55	45
Help/Control *by MDS. 123 style Help*	125	109
Microsoft MuMeth *includes MuSimp*	300	199
Microsoft Pascal Compiler *Links w/M'soft C.*	300	199
Microsoft Pascal Compiler *for XENIX*	695	546
Turbo Power Tools+ *by Blaise*	100	67
Advantage C++ *by Lifeboat Assoc.*	495	435
PHOENIX PRODUCTS		
PASM86 *Macro Assembler*	195	139
PDisk *Phoenix's new disk manager*	195	139
Plantasy Pac *six products. New Price*	995	655
PFinish *EXE performance analyzer*	395	279
Pfix86 Plus *Symbolic Debugger*	395	259
PforCe *vast library*	395	235
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The C-Worthy™ Interface Library wraps an entire user interface around your application Its full power can be summoned by only a few high level calls Sound exaggerated? A single function call can set up a complete text editor in a screen window Recently acquired by Solution System, over 600 pages of Documentation, Turbo and Quick C version and a complete Interface Library have been added

- High level calls pop menus and scrollable choice lists to the screen, restoring the background when dismissed
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Novell found it "played a key role and accelerated development" in making its NetWare™ utilities easier for users Ingenious demo call for it

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Quality software? IBM thinks so They sell GSS under their own label Royalties Needs 256k

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Kernel System	$495	$375
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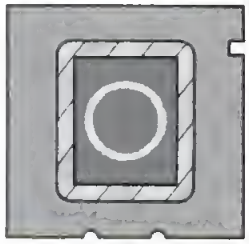
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■ MITT JONES



PC ADVISOR

Help in using a VCR as a backup device, in clearing memory-resident programs out of memory, and in recovering a partially overwritten database file.

VCR BACKUP

I have a spare VCR and am interested in using it to back up my hard disk. I've heard this is possible. Can you point me in the right direction?

John Lowe
Santa Ynez, California

Alpha Microsystems (Santa Ana, Calif.; (714) 957-8500) markets a product—the Videotrax Adapter Board—that will let you use any VCR as a tape backup unit. Recently reduced to $399, the board comes with full-featured backup software and can store up to 80 megabytes of data in 2-hour mode or 160 megabytes in 4-hour mode on standard VHS or Beta cartridges.

Videotrax ensures data reliability by storing redundant copies of the data, and overall the product seems to work well. However, you'll find that backup is substantially slower than it is with dedicated tape subsystems.

Alpha Microsystems also sells the Videotrax Subsystem for $1,199—a package that includes a VCR with wireless remote control and that gives you a few more automated features than the adapter board alone.

Either way, you can still use your recorder as a plain ol' VCR.

RIGHTING dBASE FILES

One of my employees accidentally overwrote a large *dBASE III Plus* file. The file, which represented about 1 year of work, has the same name but now contains only one record rather than the 1,600 it contained before.

I know the majority of the lost information is still on my hard disk: I found a portion of the lost data by using a hard disk file view utility, and I haven't written any information to the disk since the accident occurred.

How can I recover the data?

Orrie H. Smith
Midland Park, New Jersey

By the time this issue hits the newsstands, dSALVAGE *(Comtech Publishing Ltd., Pittsford, N.Y.; (716) 586-3365) should be available. Because* dSALVAGE *was not available as of this writing,* PC Magazine *has not evaluated it, but the developer claims that this* dBASE*-file-repair product will remedy this and many other* dBASE *file problems in minutes. Alternatively, you may be able to salvage the data using manual techniques, but you'll spend several days on the project.*

First, get your hands on a disk utility such as The Norton Utilities *or* PC Tools. *Delete your file so that you can go through a file unerase procedure. Both* The Norton Utilities *and* PC Tools *will find only the blank record during the automatic data search but will then give you the option of searching the disk manually for the remaining information.*

■ Unless you're forced to use your hard disk for data swapping, the time it takes to toggle applications will be practically nil.

Second, assuming you've somehow managed to piece your file together, order a copy of Salvaging Damaged dBASE Files, *a $19.95 publication by the developer of the soon-to-be-released* dSALVAGE. *This publication, a step-by-step guide to solving many internal* dBASE *file problems, will guide you through the procedure necessary to put the file back into the correct* dBASE *format.*

This process, especially piecing the file together using a disk utility, is extremely time-consuming and tricky and can be nearly impossible, depending on your file.

Certainly don't try it without a current backup of your entire disk, and you probably shouldn't try it at all unless you're at least somewhat familiar with disk file structure.

On the upside, maybe your experience will convince you and others to back up important data on a regular basis.

DUMPING TSR'S

I use numerous memory-resident utilities that together occupy a good bit of memory. Is there some way I can clear out the RAM the memory-resident programs use without rebooting my system?

Dave Helfrich
New Port Richey, Florida

■ **MITT JONES**

For an excellent and low-cost solution, turn to Jeff Prosise's INSTALL, REMOVE, and PCMAP utilities, featured in PC Lab Notes, PC Magazine, *Volume 6 Number 14. Used in conjunction with INSTALL, REMOVE lets you unload any memory-resident program from memory, whether or not the program offers an unload option itself.*

Referee *($69.95; Persoft Inc., Madison, Wis.; (608) 273-6000) offers similar unloading ability but in a menu-driven structure.*

You can also deactivate RAM-resident programs to keep them from clashing with each other or with an applications program. Deactivating a program doesn't clear it out of memory, however: it only keeps the program from intercepting keyboard input.

Though meant for an entirely different purpose, Software Carousel *($49.95; Soft-Logic Solutions Inc., Manchester, N.H.; (603) 644-5555) may be an even better solution, depending on your system configuration.*

Designed to let users switch instantly from one application to another, Carousel *in effect makes applications you load into any of ten partitions memory resident. You define which applications run in each partition and how much RAM each partition should occupy. A "hot key" you can define for each partition lets you switch quickly between applications without losing your place.*

Carousel *will help solve your problem because it shuffles applications programs in and out of lower memory (640K bytes on most systems) when you change partitions. No one partition can require more memory than your system's lower memory, and the sum of the memory that is required cannot exceed the total space that is available for swapping. But* Carousel *is able to use extended memory, Lotus/Intel/Microsoft expanded memory, RAMdisks, and—as a very slow last resort—hard disk drives for data swapping.*

For example, rather than loading SideKick *on top of* dBASE *and occupying the lower memory required for both, you could load each into a separate partition and toggle back and forth. Unless you're forced to use your hard disk for data swapping, the time it takes to toggle applications will be practically nil, and you'll have plenty of RAM to work with in each partition.*

Carousel *also lets you unload any program from memory at any time, and you can have the some memory-resident program running by itself or on top of other programs in any or all partitions.*

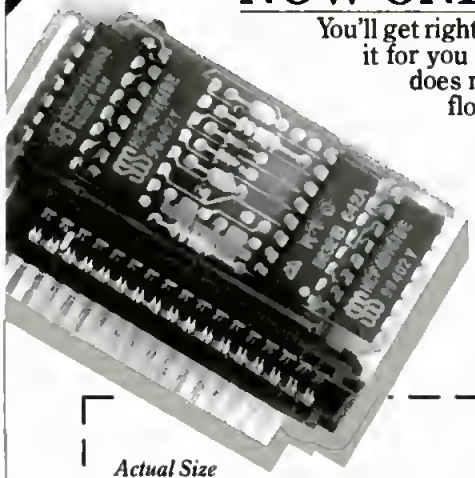
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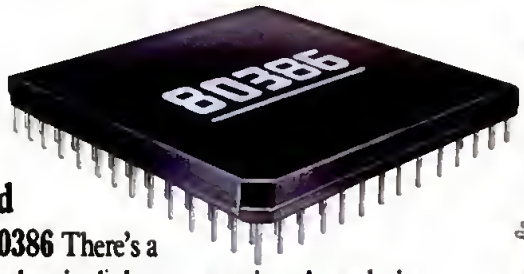
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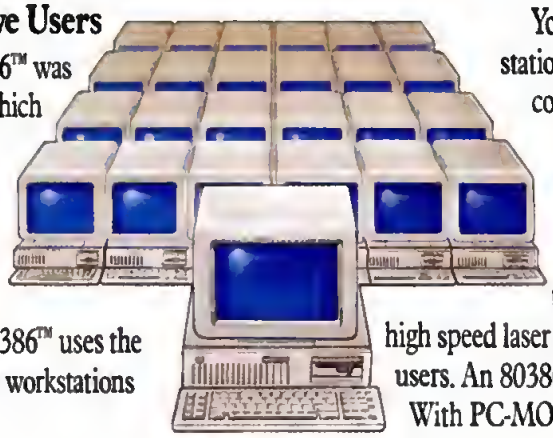
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2. PC and PS/2 Compatible In designing PC-MOS, we knew our first priority was to exploit the minicomputer capabilities of 80386-based PCs & PS/2s. But we went further, and developed a system which would be fully compatible with the millions of existing PCs, PC ATs, and PC-compatibles. Power without sacrifice. You'd expect nothing less from the new standard bearer.

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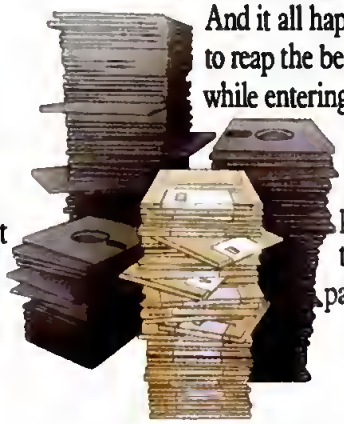
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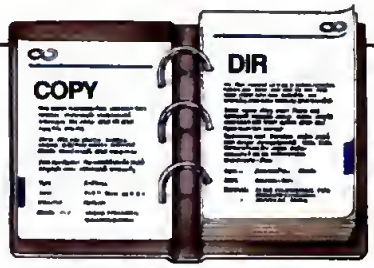
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When you decide to implement either a network or a multi-user system, there's a two-fold problem which must be solved: protecting your work from accidental misuse and securing it from intentional theft.

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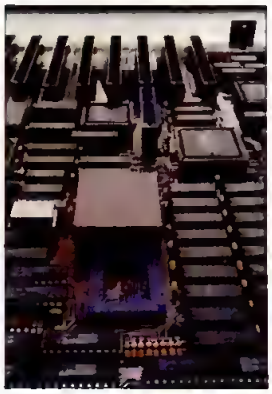


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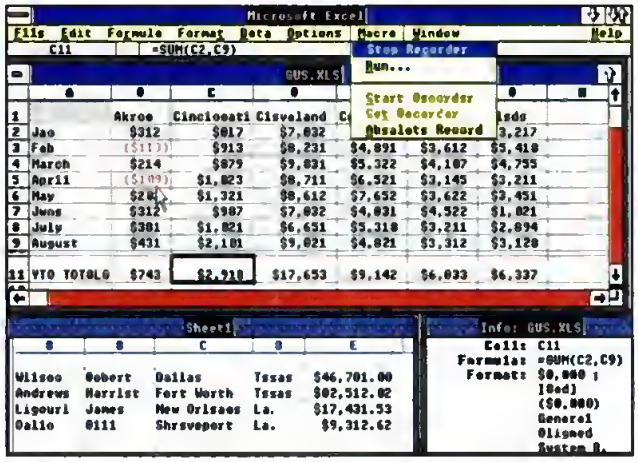
FIRST LOOKS

Excel: Microsoft's Second-Generation Spreadsheet

HANDS ON

BY JARED TAYLOR

Look out, Lotus. Microsoft Corp. has just unleashed a spreadsheet that makes *1-2-3* look like a rough draft. The boys from Redmond have packed just about every imaginable feature into a program that sets the standard for a new generation of spreadsheets. The future doesn't come cheap, though. Microsoft's *Excel*, which is based on the Macintosh program, requires an AT-class machine and DOS 3.*x*, and you'll probably want an EGA monitor and a mouse. But if you should have the hardware, *Excel* has the horsepower.



In this Excel *session, two worksheets are open. The bottom right window is displaying status information on the top worksheet. Notice that the top worksheet is taking advantage of an* Excel *option to display negative numbers in red. The bottom left worksheet displays gridlines and headlines in blue, for contrast against the other worksheet.*

For people who are used to *1-2-3*, *Excel* doesn't even look like a spreadsheet. It comes bundled with a run-time version of *Microsoft Windows* that makes your PC look like a Macintosh with color. *Excel* treats the entire screen as graphics, so you can mix text and pie charts, use multiple fonts, and paint things different colors. This isn't just a matter of cosmetics. You can call attention to important numbers by making them bigger or by giving them a different background, and you can display all negative numbers, say, in red. If you use a little ingenuity, the screen doesn't have

(continues on page 34)

Compaq's 20-MHz Deskpro 386: The First Desktop Rocket Ship

HANDS ON

BY BILL MACHRONE

It takes more than megahertz to make a fast computer. Compaq Computer Corp. has been proclaiming loudly that AT-bus machines ("industry standard," in Compaq's parlance) have a long and brilliant future. Further, it says, IBM's Micro Channel Architecture is unnecessary to achieve ultimate DOS and OS/2 performance.

With the 20-MHz 386, Compaq is putting its money where its mouth is. This machine accepts all the I/O boards you've come to know and love, while running at a blistering 20 MHz. The new Compaq Deskpro 386/20 accomplishes this feat by separating the high-speed memory bus and low-speed peripheral bus. It neatly sidesteps all the issues about dynamic, static column, and static RAM by being the first machine to use Intel's new 82385 cache and bus controller.

The new chip harnesses 32K bytes of 35-nanosecond static RAM with up to 16 megabytes of slower dynamic RAM for performance that's even better than you would expect from the 25 percent increase in clock speed. The 80386 reads and writes to and from the cache at full speed. The 82385 fetches from and writes to the main memory at a more leisurely pace, allowing the use of more affordable, less-space-consuming dynamic RAM.

The 32K bytes may not seem like much space in which to cache 16 megabytes, but it's plenty, thanks to the pipelined architecture of the 80386. Pipelining is the means by which the processor fetches data before it

(continues on page 35)

HANDS-ON INDEX

COMPAQ PORTABLE 386
No one else is even close .. 35

TWO PS/2 BOARDS
AST and Quadram ship add-in RAM for the 286-based PS/2s 36

MICROSOFT WORD 4.0
Faster, smarter, and no more Alpha key 38

DAC EASY WORD II
Remarkable for the price .. 43

SHARP PC-4501
A $1,295 laptop 43

ZENITH ZCM-1490
A glare-free display based on flat-tension mask technology..... 48

Microsoft Excel

(continued from page 33)

to look like rows and columns at all, and your charts can be absolutely presentation quality.

Excel can be installed to run either standalone with the runtime version of *Windows* or in a *Windows* environment under the soon-to-be-released *Windows*, Version 2.0. *Excel*'s Mac-like interface cries out for a mouse, but you can work the program reasonably well without one. There are shortcuts attached to every function key and to almost every shifted and control-shifted function key. Even obscure combinations like Ctrl-Shift-Spacebar and Alt-Shift-Esc do useful things.

Besides its interface, *Excel*'s other major advance is its calculation algorithm. If you make a small numeric change, *Excel* is smart enough to recalculate only the formulas that are affected, not the whole silly spreadsheet. And even when calculation takes a long time, it doesn't hog the machine. *Excel* suspends recalc as soon as you hit a key and starts it up again only when you're through.

In terms of basic spreadsheet functions, *Excel* is miles ahead of the competition. It has 131 built-in functions—42 more than *1-2-3*—and 21 standard number and date formats. If you want more formats, or even more functions, you can design your own. And in case you lose track of all those functions, you can call them up on a screen and just paste them directly into your model. No typos.

Cell Notation

Another real gift to the user is a fistful of tools to keep your spreadsheet honest. You can attach notes to individual cells, explaining the thinking behind your formulas. If you need to troubleshoot, you can run a quick check to see which formulas depend on a particular cell or which cells a particular formula depends on. If you find a consistent reference error, you can correct it at one stroke with a search-and-replace function that works with formulas as well as text. Circular errors are a breeze to track down.

In terms of basic spreadsheet functions, *Excel* is miles ahead of the competition. It has 131 built-in functions—42 more than *1-2-3*—and 21 standard number and date formats.

Another kind of check tells you where you have values when you meant to have formulas, or vice versa. You can even check a series of formulas to be sure they are all in the same pattern.

To eliminate pesky rounding errors, you can use precision-as-displayed. This means a number really *is* what it says it is, and you won't ever have cross-footing errors. If you actually do make a mistake, *Excel* has seven different error messages, so you'll have a good idea of what you did wrong. And you can always snatch it back with that real lifesaver, an undo command.

For all the sheet spreaders who have clamored for quick consolidation, *Excel* lets you link models by including references to cells in other spreadsheets. If you refer to more than one external spreadsheet, however, they all have to be in memory together. The point of consolidation is to link lots of spreadsheets, so *Excel* has taken a minimal approach that is a far cry from real 3-D.

Data Entry Forms

Excel's database does essentially what *1-2-3*'s does. It's more convenient, though, since you can use data entry forms rather than type new records in, row by row.

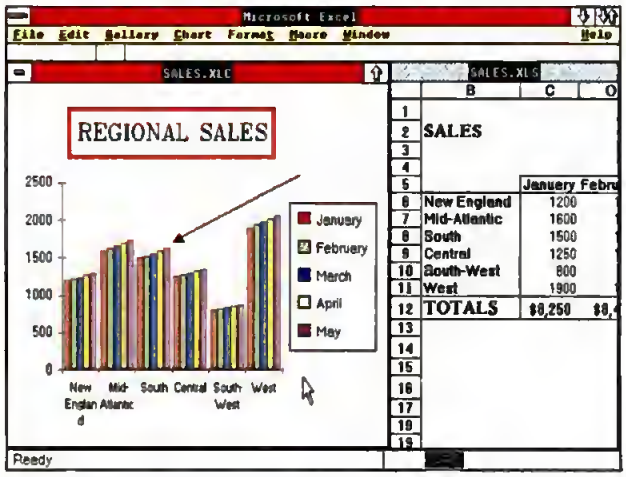
As you'd expect from a graphics-based spreadsheet, *Excel*'s charts are outstanding. There are seven basic types, in an amazing 44 different predefined formats. But best of all, they're a snap to use. Just highlight the data you want to graph and pick a graph type. *Excel* is smart enough to know that the rows of numbers are data series, and that the text along the top and side is graph labels. You can add more text wherever you like, change colors and fonts, and even emphasize a data point by drawing an arrow to it. If you design an especially slick graph, you can save its format and use it again.

Some of *Excel*'s very best goodies are hidden away where only the hackers will find them. Its macro language is the richest and most powerful available in a microcomputer spreadsheet. You can record macros from the keyboard or use its 355 commands and statements to write full-blown applications. These could include custom menu bars and fully interactive dialog boxes. You can write macros that execute at a certain time of day, or when data changes, or when you close a spreadsheet. You can test for whether a spreadsheet has been changed since it was last saved. You can even use macros to remap the entire keyboard to the commands of your choice.

At an even deeper level, when running *Excel* under *Windows* 2.0, you'll be able to use macros for two-way communications with other programs running under *Windows*. And strictly for programmers, there's a set of macro commands that let you run your own C routines from within *Excel*.

As good as *Excel* is, Microsoft hasn't forgotten that it has an uphill fight against *1-2-3*. The program reads *1-2-3* files and macros, and there are even special help screens that tell you the *Excel* equivalents of *1-2-3* commands.

After years in the twilight as a great business application that—gulp—ran only on the Mac, *Excel* has finally come in from the cold. It'll get an enthusiastic welcome.



In the right window is a spreadsheet using several fonts, and with grid lines turned off. In the left window is a chart that is dynamically linked to the spreadsheet: change a number in the graphed range, and bars on the graph move.

PC MAGAZINE FACT FILE

Excel
Microsoft Corp.
16011 NE 36th Way
Box 97017
Redmond, WA 98073-9717
(206) 882-8080
List Price: $495
Requires: 640K RAM, AT or 386 machine, hard disk drive, color/graphics monitor, DOS 3.0 or later. EGA and mouse recommended.
In Short: A powerful, full-featured, graphics-interface spreadsheet. Not copy protected.

CIRCLE 400 ON READER SERVICE CARD

Deskpro 386/20

(continued from page 33)

actually needs it. The 82385 monitors these fetches and, if the data isn't in the cache, retrieves it from main memory by the time the 80386 is ready to use it. As a result, the cache has the desired data (called a hit) 95 percent of the time.

The new Deskpro 386/20 is no slouch in the hard disk department, either. Its 130- and 300-megabyte drives clock in at under 20 milliseconds average access time. These drives sport an ESDI controller sufficiently fast to allow a 1:1 interleave on the hard disk. These specs translate to near-instantaneous performance; programs leap at your command from the disk to the screen. The 60-megabyte non-ESDI drive holds its own at 28 milliseconds, too. It doesn't have the sudden response of the big drives, but it's certainly up to the task if you don't require the big megabytes.

The ESDI disk subsystems are fast enough to make the Deskpro 386/20 a breathtaking file server, too. For present-day applications, the incredible CPU speed may be overkill: that's not where file servers tend to need performance. In the future, however, when file servers will also run database and communications tasks, users will look to leadership machines such as this.

Even the video is faster on the 20-MHz Deskpro. EGAs are notoriously slow to accept characters and instructions from the processor. The number of machine cycles wasted in waiting for video rises dramatically with the increased speed of the machine. Compaq tackled this one by re-engineering its EGA card and designing some new circuitry that yields zero-wait-state video writes. As with the original Deskpro 386, Compaq runs a copy of the BIOS, including the EGA BIOS, in 32-bit memory. This technique, called shadowing, is much faster than going through the slow system ROMs. Together they give the new machine stellar video performance. No other machine has even come close on our EGA performance tests.

Inside, the Deskpro 386/20 has the familiar Compaq stamp: heavy metal brackets and overall solidity. It has the metal fingers and interlocking channels that first appeared on the 16-MHz machines to keep radio interference within the cabinet. The motherboard, however, is entirely new. It divides the system into high-speed and low-speed areas. The 80386, the 82385, the cache memory, and the 80387 coprocessor are in the high-speed section. The rest of the motherboard is low-speed. You can easily see the two sections, as the high-speed section

(continues on page 36)

Portable 386: More Powerful than the Fastest (Non-Compaq) Desktop PCs

PC HANDS ON

BY GUS VENDITTO

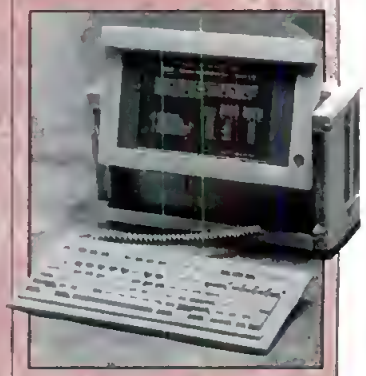
Critics who accuse Compaq Computer Corp. of being a follower will have to retire the label officially.

Compaq is celebrating the 1-year anniversary of the original Deskpro 386 with a double whammy: the Deskpro 386/20 (see review, page 33) and the fastest portable PC yet, the Portable 386.

The same box that Compaq used 6 months ago in designing the 12-MHz, 286-based Portable III is housing a 20-MHz 386 this time. This 21-pound lunchbox computer races through applications, with hardly a pause for disk access: the seek times on the 40-megabyte Model 40's hard disk clocked in at 28 milliseconds. That's a full 62 milliseconds faster than the closest competitor, the Toshiba T3100/20.

Like the Portable III, a high-density, 5¼-inch floppy disk drive is standard and an expansion chassis plugs into the rear; proprietary internal memory and modem boards are available from Compaq. Serial, parallel, and RGB ports are standard.

Topping it all is Compaq's own brand of DOS 3.3, which breaks DOS's 32-megabyte disk size restriction. And you can put it to good use: you have your choice of a 40- or a 100-megabyte internal disk.



List Price: Compaq Portable 386, Model 40, $7,999; Model 100, $9,999; 100-Mbyte expansion hard disk, $4,299; 40-Mbyte tape unit, $999; 32-bit memory/modem interface, $70; 1,200-bps internal modem, $349; 2,400-bps internal modem, $699; expansion chassis, $199; 80387 coprocessor, $1,199. Compaq Computer Corp., 20555 FM 149, Houston, TX 77070; (713) 370-0670.

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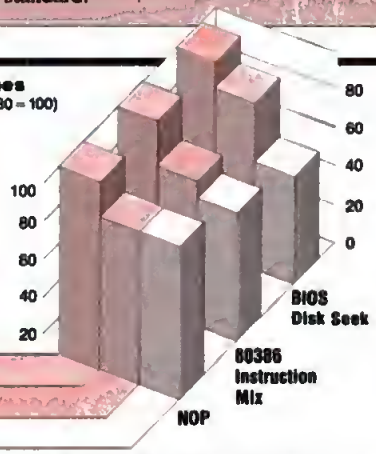
PC LABS

Benchmark Tests: Compaq Portable 386 and Compaq Deskpro 386/20 vs. IBM PS/2 Model 80

The white-hot speed of Compaq's two new 386 PCs take top honors for personal-computing performance. The Deskpro 386/20 is faster than the Portable 386 on the 80386 Instruction Mix test because the Deskpro uses static RAM. IBM's 20-MHz 80386 PS/2 Model 80 is due out later this year.

Performance Times
(Times given in seconds except where noted)

	NOP	80386 Instruction Mix	BIOS Disk Seek (milliseconds)
IBM PS/2 Model 80	2.10	4.30	33.00
Compaq Portable 386	1.70	3.30	28.47
Compaq Deskpro 386/20	1.70	2.91	18.46



The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instruction in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

More PS/2 RAM from AST and Quadram

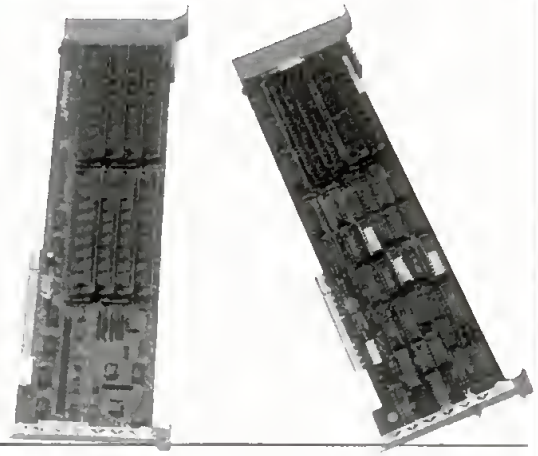
PC HANDS ON

BY MITT JONES

Watching your memory-check counter flip through 9,216K bytes of RAM at start-up can be a bit heady, to say the least. But it's a feeling you definitely won't want to be without once you've tried it.

IBM's setup program for the PS/2 Models 50 and 60 places an artificial limit of 2 megabytes on the amount of RAM that can be recognized on one board, but both AST Research and Quadram Corp. defeat the limit in their first offerings for the Micro Channel—AST by altering one of IBM's setup files (reportedly with IBM's blessing) and Quadram by providing a special driver.

AST's Advantage/2 distinguishes itself as the first board we've tested fully loaded with 1-megabyte SIMMs (single in-line memory modules), providing its maximum per-card capacity of 8 megabytes.



The Advantage/2 (left) has twice the capacity, up to 8 megabytes, of the QuadMeg PS/Q with its four additional banks of nine 120-nanosecond SIMM's.

Quadram's QuadMeg PS/Q arrived half-loaded with 256K SIMMs, yielding 512K RAM. Fully configured with 1-megabyte SIMMs, the QuadMeg packs 4 megabytes.

One-megabyte SIMMs are still not readily available, but AST says fully loaded Advantage/2 boards are shipping with only short delays.

The Advantage/2 and QuadMeg both include RAMdisk and print-spooler drivers that use conventional, extended, or expanded memory. The Advantage/2 also provides for attachment of an optional piggyback board that gives you either two serial ports or one serial and one parallel.

Installation of the QuadMeg proved troublesome, primarily because of two errors in the documentation, but once installed the QuadMeg and the Advantage/2 performed flawlessly.

Each board ships in a variety of memory configurations and allows you to boost capacity later by installing additional SIMMs. Each gives you a choice of using the BIOS ID number that IBM reserved for its own memory card or using the ID number that IBM assigned to these boards. PC

PC MAGAZINE FACT FILE

Advantage/2
AST Research Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
List Price: 512K RAM, $495; 1 Mbyte RAM, $695; 2 Mbytes RAM, $995; 4 Mbytes RAM, $1,995; 8 Mbytes RAM, $3,995; optional I/O module, $175.
Requires: PS/2 Model 50 or 60.
In Short: A multifunction board for PS/2 Models 50 and 60 that offers up to 8 megabytes of RAM on one card and two I/O ports on a piggyback board.

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QuadMeg PS/Q
Quadram Corp.
One Quad Way
Norcross, GA 30093-2919
(404) 923-6666
List Price: 512K RAM, $545; 2 Mbytes RAM, $995; 4 Mbytes RAM, $1,895.
Requires: PS/2 Model 50 or 60.
In Short: A memory board for PS/2 Models 50 and 60 that's available with up to 4 megabytes of RAM.

CIRCLE 414 ON READER SERVICE CARD

Deskpro 386/20

(continued from page 35)

has a low metal fence around it, the better to contain RF emissions. The 32K bytes of cache memory are completely covered by a perforated metal shield, again to control RF.

The Deskpro 386/20 is, quite simply, the fastest machine PC Labs has ever tested. Like an air superiority jet fighter, it dominates every single performance measurement. This performance does not come cheap. Even a stripped-down model will set you back about $7,500 or so.

But this machine is clearly destined to be more than the ultimate spreadsheet scruncher. Compaq's engineers have built in the ability to use the Weitek 1167 math coprocessor chip set. This chip set is highly favored by the scientific and engineering crowd and yields performance well into the upper reaches of minicomputer-based systems. A number of packages have already been rewritten for the Weitek chip set; more are on the way. Several popular compilers will also generate Weitek-compatible code in future versions. The Deskpro 386/20 can also run the Intel 80387 at the same time, so you can go from the fastest *AutoCAD* redraws ever to the fastest *1-2-3* recalculations ever.

Compaq has reproven its technical leadership and its commitment to being the performance and compatibility leader in the PC marketplace. This is a forward-looking machine that hasn't forgotten its roots. This thing is a desk-bound rocket ship! PC

PC MAGAZINE FACT FILE

Compaq Deskpro 386/20
Compaq Computer Corp.
20555 FM 149
Houston, TX 77070
(713) 370-0670
List Price: Model 60, $7,499; Model 130, $9,499; Model 300, $12,499; 1-Mbyte RAM upgrade, $549; 4-Mbyte RAM upgrade, $2,099; 386K-byte 5¼-inch floppy disk drive, $225; 1.2-Mbyte 5¼-inch floppy disk drive, $275; 1.44-Mbyte 3½-inch floppy disk drive, $245; internal 40-Mbyte tape drive, $799; 135-Mbyte tape drive, $1,999; monochrome monitor, $255; monochrome adapter, $199; color monitor, $799; enhanced color adapter, $399; 80387 coprocessor, $1,199; Weitek coprocessor, $1,999; DOS 3.3, $120.
In Short: The fastest desktop PC you can buy, with outstanding use of the latest technology, including Intel's memory management chip. Expensive, but worth the money.

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Word 4.0 Links to Spreadsheets, Produces Style Sheets "by Example," Runs Faster

PC HANDS ON

BY JOHN DICKINSON

Microsoft Word, Version 4.0, is here, and Microsoft Corp. has added so many new features it's hard to know where to begin. Probably the only simple thing you can say about the new edition of *Word* is that it has a gaggle of new toys that are just what word processing power mongers have been looking for.

Macros are easily the most powerful new feature in *Word* 4.0. They're typical of Microsoft's approach to *Word* in that the program provides two ways to create macros, and two ways to use them, and they have features that users of DOS macro processors might kill for.

One power user feature that will certainly appeal to corporate types is spreadsheet linking, which allows you to merge a range from a *1-2-3*, *Multiplan*, or *Excel* spreadsheet into a *Word* document without any conversion effort. When combined with *Word*'s new line, box, and border drawing, which gives you a variety of methods for highlighting blocks of text, spreadsheet linking gives you a simple but powerful facility for producing good-looking reports.

Word now knows how to count pages and lines while you're editing, and it can display your current position on-screen. It can also print line numbers on your hard copy if you wish, and it counts words as it prints.

Document control is further enhanced by *Word*'s new document retrieval feature. Like more traditionally corporate word processors, *Word* 4.0 lets you add facts about the document, such as author and version number, when you save it.

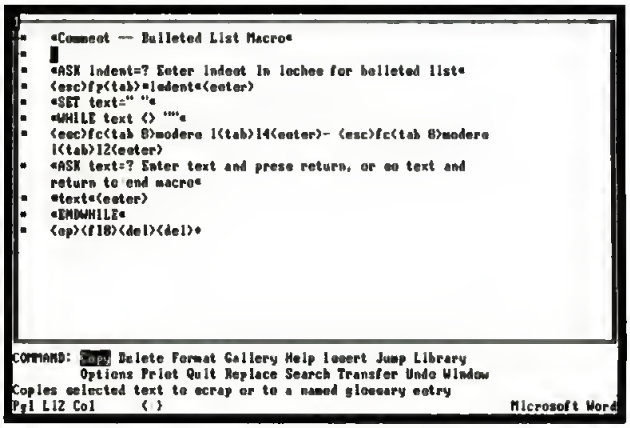
Power users who like using *Word*'s style sheets will rejoice over the new "style by example" feature. After you've adjusted your character, paragraph, or division formats to your liking on-screen, you can tell *Word* to add their formats to the current style sheet, using character codes you specify. This makes style sheets easier to create and much more accessible to new users of *Word*. Now you can also use *Word* to search for formats—either by style sheet code or free format characteristic—and to replace them as well.

There are many more new (albeit lesser) features in *Word* 4.0, but the really important ones for *Word* users—and would-be users—have to do with *Word*'s command menu system. Probably the best news on the menu is that the much-maligned Alpha command is gone. In previous editions of *Word*, you used the Esc key to access the menu, and the Alpha command to return to editing your document. In *Word* 4.0 the Esc key is a toggle—you just press it again to get back to your document.

The other big *Word* menu news is in the navigation department. Instead of using odd combinations of the Tab key and Spacebar to select *Word* commands, you use the PC's cursor keys, which all work in the expected ways. Speaking of keys, *Word* 4.0 now offers four (count 'em, four) commands per function key—except for F11 and F12, which have only two commands each.

And yes, *Word* 4.0 is faster than any previous version. It's the first version that is comfortable to use on a hard-disk-equipped standard PC or XT. If you have a graphics screen, you get a sort of built-in turbo effect—the Alt-F9 key combination instantly switches you between graphics and text modes.

The upgrade to *Word* 4.0 costs $75 for current *Word* users, and Microsoft's suggested retail price for the product is $450. Take a close look—it's well worth the price. PC



Gone is the annoying Alpha menu choice. Added are command synopses; page, line, and column counters; and a full macro language.

Word Macros: Simple (Auto-Recording) And Powerful (Conditional Branching)

Microsoft Word finally has a macro processor in Version 4.0, and it's a pretty good one at that. The implementation is well thought out, and there isn't much *Word* can do that can't be programmed into a macro—in fact, there's more here than *Word* can do by itself.

To create a macro you can tell *Word* to record your keystrokes or type the source code. You store the macro in a glossary attached to your current document. You can assign it an ordinary glossary entry name, and you can assign it a keystroke. Keystroke assignments must be Ctrl-key combinations.

Word macros can have "while loops" and "for loops" (sorry, BASIC fans, no "goto"). You can control loops by means of user input data, check for flags such as "found" and "notfound," interact with the user, pause, and, of course, insert comments.

I have but two serious gripes with *Word* 4.0's macros. One is that they're stored in a glossary. That seemed a reasonable idea until I discovered how painful it is to make sure that every document has access to the same glossary—it isn't always appropriate, and that means storing and maintaining multiple copies of the same macros.

The other gripe is that an "end of macro" message always appears and blithely covers up the message text from the command just executed—which may have been the entire reason you wanted the macro to run!

—John Dickinson

PC MAGAZINE FACT FILE

***Microsoft Word*, Version 4.0**
Microsoft Corp.
Box 97017
16011 NE 36th Way
Redmond, WA 98073
(206) 882-8080
List Price: $450; upgrade, $75.
Requires: 256K RAM, two disk drives, DOS 2.0 or later.
In Short: *Microsoft Word*, Version 4.0, brings power users a gaggle of new features while improving the program's speed. Not copy protected.

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KEVIN HOWE, PRESIDENT
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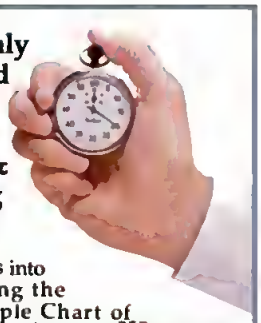
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PC MAGAZINE

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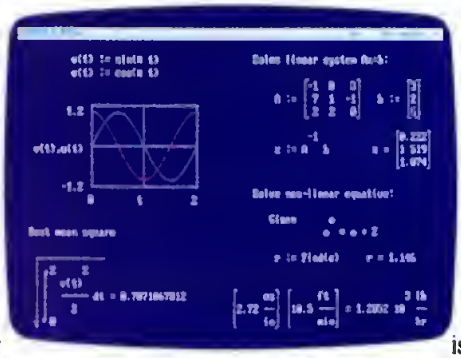


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$50 Dac Easy Word II: Powerful and Erratic

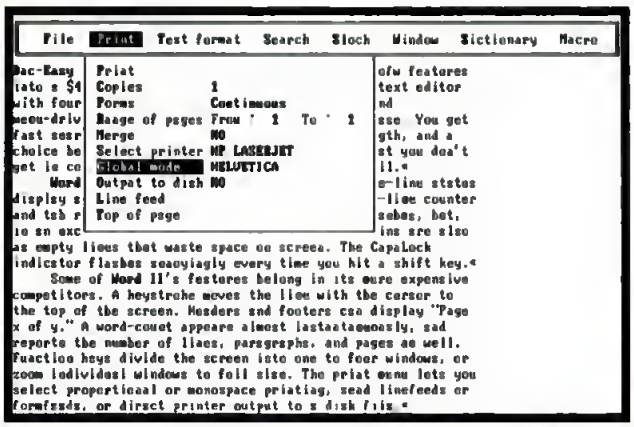
PC HANDS ON

BY EDWARD MENDELSON

Dac Easy Word II packs an impressive set of features into a $49.95 word processor. Dac Software's rewritten version of last year's *Word I* gives you four windows, spelling checker, macros, timed backup, and menu-driven mail-merge linked to a built-in database. You also get quick searching and scrolling, unlimited file length, and a choice of pull-down menus or speed keys. What you don't get, unfortunately, is total reliability or attention to detail.

At its best, *Word II* is clean and efficient. You see almost exactly what you get. Top and bottom margins appear on-screen as they appear on the page, with optional headers or footers and page numbers in the form "Page *x* of *y*."

One keystroke moves the line with the cursor to the top of the screen. Function keys or a menu will divide the screen into one to four windows, and you can zoom each window to full-screen size and back again. The print menu lets you select proportional or monospace printing, send line-feeds or form-feeds, or direct the printer output to a disk file. You can get a word count without waiting.



Dac Easy Word II's print menu allows you to set options and format, including merge files. Laser printer users can select proportional fonts.

Although *Word II* is almost effortless to use, its menus, unlike those in *PFS:Professional Write*, aren't clear enough for the occasional or one-time user. You might expect to use the File menu to store a file and start a new one; *Word II* expects you to use the Window menu instead.

Word II is erratic in its frequent confusion over layout and print modes. Newly typed text sometimes gets indented one or more spaces for no apparent reason; you have to remove the extra space by hand. At unpredictable moments, the program won't permit you to add any letters to the end of a word that precedes a bold or underlined word—the added characters attach themselves to the next word instead.

If you can live with these quirks, *Word II* can give you all the word processing you need for small-business use, where it makes an ideal companion to *Dac Easy Accounting*. And it's ideal for light correspondence if you're on a budget. PC

PC MAGAZINE FACT FILE

Dac Easy Word II
Dac Software Inc.
4801 Spring Valley Rd., Bldg. 110B
Dallas, TX 75244
(800) 992-7779
(214) 458-0038
List Price: $49.95
Requires: 256K RAM, two disk drives, DOS 2.0 or later.
In Short: A powerful word processor and mail-merge/database package at a bargain price. Not copy protected.

CIRCLE 399 ON READER SERVICE CARD

Sharp's $1,295 Laptop Runs the 80188

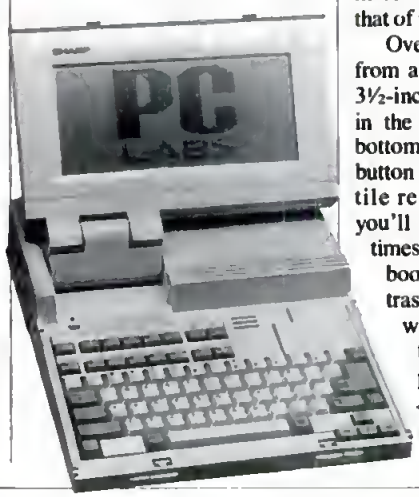
PC HANDS ON

BY GUS VENDITTO

In an age of specialization, Sharp Electronics Corp. seems determined to build a full line of portable PCs. Its PC-7100s are XT-speed lunch boxes with bright backlit displays, 5¼-inch floppy disks, and hard disks; its PC-7200s pushed that design to AT levels but was cut off at the border by the tariff on Japanese 16-bit portable computers.

Now the PC-4501 stretches Sharp's line into true laptop territory. It's built around a clone of Intel's little-used 80188 processor, which offers the advantages of 16-bit internal and 8-bit external processing, provides you with decent 7.16-MHz performance, and lets Sharp avoid the 16-bit laptop tariff.

The PC-4501 matches the Toshiba T1000 and T1100 with its supertwist LCD, but it demands far more squinting in poorly lit quarters than NEC's and Zenith's lightweights with backlit displays. Sharp's keyboard is up there with the best of them. It has a springier feel and more keyboard real estate than that of the IBM Convertible.



Sharp's 10-pound laptop has an excellent keyboard.

Overall, the PC-4501 suffers from a few design quirks. The 3½-inch floppy disk drives are in the wrong positions: A on bottom, B on top. The power button provides virtually no tactile response, ensuring that you'll turn it on and off a few times before you get to see it boot. And the screen contrast dial, the most fiddled with component on a laptop, is unobtrusive to the point of becoming lost.

What the PC-4501 does have going for it is price. At $1,295, it's a bargain—close to the Toshiba T1000, which at $1,195 is limited to one disk drive. PC

PC MAGAZINE FACT FILE

Sharp PC-4501
Sharp Electronics Corp.
Sharp Plaza
Mahwah, NJ 07430
(201) 529-8200
List Price: $1,295
In Short: Ten-pound laptop with supertwist LCD and good keyboard, built around a clone of Intel's 80188 processor.

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QUICK LOOKS

Fast Forward Caches Reads and Writes

PC HANDS ON

BY STEPHEN RANDY DAVIS

The latest entrant in the disk-caching fray, Mark Williams Co.'s *Fast Farward*, brings a refreshing simplicity to the management of a cache, since it's completely menu oriented.

Like other disk caching programs, *Fast Farward* increases disk performance by keeping the most recently read sectors in RAM to save on disk seeking. PC Labs benchmark tests confirm that it does speed file access by about 150 percent. *Fast Forward* also offers the option of cutting down on disk writes.

Many cache programs provide user control at installation via complicated switches. *Fast Forward* provides control through pop-up windows.

Fast Farward allows three options for disk write requests: they can go directly to disk, can be held until the disk is not busy, or can be kept in RAM until you manually flush the contents to disk. Under the "direct to disk" options, disk writes work the same as without a cache. Under the other two options, write performance is increased, but if there's a power loss before the write requests can be honored, your data will be lost. These options give you fast performance at only a small risk, since *Fast Forward* monitors the floppy disk's presence and will warn you if you remove the disk before it's had a chance to save data.

List Price: *Fast Forward*, $69.95.
Requires: 256K RAM; two disk drives; DOS 2.1 or later. Not copy protected. Mark Williams Co., 1430 West Wrightwood, Chicago, IL 60614; (312) 472-6659.

CIRCLE **420** ON READER SERVICE CARD

Zoo Keeper: A Whip for Unruly Disks

PC HANDS ON

BY MITT JONES

If you've got a hard disk and use it to store more than the grocery list, the question isn't whether you should get a file finder, but which one you should get.

Utilities that search directories for a filename and then return the path are common. High-powered programs that search the contents of every single file for the text you specify also abound. But Polaris Software's *Zoo Keeper* offers a different approach.

Occupying 32K bytes of RAM, *Zoo Keeper* pops up each time you or one of your applications programs creates a file, provided the file extension is one you've specified for cataloging during installation. A small menu prompts you to enter as many as three keywords of your choosing, plus a 40-character file description. To locate a file later, you access the search screen and specify keywords for the file you need. The DOS filename is always used as an additional keyword.

Zoo Keeper almost immediately displays a list of the matching files, along with their descriptions and DOS paths. You can then view more information about a file, erase files, or load a file specification into a DOS command or application.

Is *Zoo Keeper* for you? That depends on your specific flavor of disorganization. It takes a bit of forethought and effort—a little organization—to put *Zoa Keeper* to really good use. It's one of those products that probably won't help you get organized unless you have a fairly good sense of organization to begin with. You'll also need to specify keywords for your existing files before they'll be included in your searches—an investment of time that may or may not be worth the trouble.

List Price: *Zoo Keeper*, $75.
Requires: 190K RAM, hard disk drive, DOS 2.0 or later. Not copy protected. Polaris Software, 613 West Valley Parkway, #323, Escondido, CA 92025; (619) 743-7800.

CIRCLE **421** ON READER SERVICE CARD

Distance Yourself from Your Computer

PC HANDS ON

BY CATHERINE D. MILLER

A PC takes up a lot of desk space. Some people have space under their desks for their system unit, but it's not an option for everyone, especially if the PC is being used for demos or occasional data entry. The Extender, from Cybex Corp., solves this problem by putting room between your system unit and your monitor and keyboard.

The Extender works like an extension cord with line drivers. It consists of two small metal boxes, the system unit end and the remote end, connected by a ⅜-inch-diameter cable. The cable can be from 25 to 250 feet.

The Extender is incredibly easy to set up. The system unit end has a connector for the monitor and one for the keyboard. You plug these into your system unit where you would normally plug in your monitor and keyboard. The remote end has a socket for your keyboard and one for your monitor. Plug your keyboard and monitor connectors into these. That's all there is to it—no tools or external power necessary.



The Extender's installation is as simple as plugging in the cable.

This product tested well on an IBM PC, XT, and AT, as well as several clones. If you want to get your system unit off your desk, or out of your office, The Extender offers you a way to do it.

List Price: The Extender, 25 feet, $99; 50 feet, $139; 100 feet, $169; 150 feet, $199; 200 feet, $249; 250 feet, $299.
Requires: IBM PC, XT, AT, or 100 percent hardware-compatible computers and monitors. Cybex Corp., 1860-B Sparkman Dr., Huntsville, AL 35816; (205) 830-1100.

CIRCLE **419** ON READER SERVICE CARD

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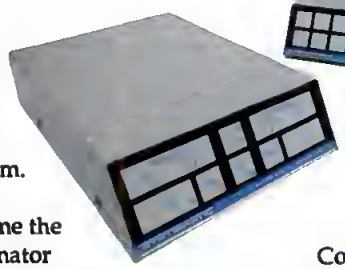
If you're thinking about sharing printers via a multi-port printer sharing box, we've got an alternative for you—one that's been proven to be superior by thousands of major corporate and government PC decision makers.

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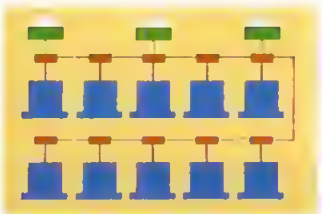
Our Systemizer and Systematic are **networking printer buffers.** As with any printer buffer, there's an input for a computer and an output for a printer. But unlike any other printer buffer, these have a third connector that lets them link together to form their own Local Area Network. Up to 15 computers, when each is equipped with a Systemizer or Systematic, can share from 1 to 15 printers. This accomodates systems ranging from those where every user has his own printer to those where everyone is sharing a single printer, and every variation in between. That's versatility!

They're compatible with practically any piece of equipment too: PC's, engineering workstations, terminals, mainframes, modems, plotters, laser printers... anything with a standard parallel or serial connection. Not only does this help insure compatibility but it also gives you total flexibility as to equipment placement.

But the real beauty comes from the way these pups are linked together in their own LAN. Our network can extend as far as 1200 feet—try that with a multi-port octopus box (the wiring bill alone would kill you)! Also note that our buffers are networked—*not* your computers. This means there are none of the hardware and software compatibility problems associated with LAN's. This also means any mix of computers and printers, of almost any brand or model, can participate in this sharing system.



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Our *distributed processing* approach to printer sharing distributes the workload. Each user has his own high speed microprocessor, buffer memory and easy-to-use control panel—dedicated to handling just his work. Compare this to a single multi-port sharing box, with its single processor, creating a bottleneck as it tries to simultaneously keep up with data coming from several computers *plus* feed data to one or more printers. Which is more appropriate for today's high speed computers and laser printers?

Another benefit of our distributed sharing system is its high degree of fault tolerance. Again, compare our method to a single multi-port box. When one of those breaks down every user in the entire office goes down with it. Isn't this called "putting all your eggs in one basket"?



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Zenith's Flat-Screen Monitor: Fully Saturated Color Without Any Glare

PC HANDS ON

BY ROBERT L. HUMMEL

Some said it couldn't be done. But Zenith Data Systems retooled an Illinois factory to make it work and is now shipping its latest engineering marvel: an analog RGB color monitor with an absolutely flat screen. Based on a technology perfected by Zenith after other manufacturers had given up, the new 14-inch Zenith ZCM-1490 CRT produces a brighter, sharper image with virtually no distortion.

Seeing the flat-tension mask (FTM) screen for the first time, you'll be impressed by the brilliant image, thanks to fully saturated colors. Text and graphics seem vibrant, even in full-room overhead illumination. Best described as a flat, perfectly rectangular screen with square corners, the display is filled with image from edge to edge and top to bottom. There are no wasted areas due to rounding, and no distortion.

The ZCM-1490 incorporates several separate enhancements to the state of the art that work well together. Among them, the FTM is probably the most significant.

Images on a CRT are produced when a beam of electrons strikes the phosphor coating on the inside of the display. With a color monitor, this job is made more difficult by the presence of three phosphors: red, green, and blue. To make sure that the electron beam illuminates the desired portion of the screen, a perforated metal screen called a shadow mask is used to focus the image.

With conventional monitors, the shadow mask is curved, to match the shape of the screen itself. As the temperature of the metal mask rises, its shape becomes distorted. Since the image must pass through this mask, it too becomes distorted. The resulting image appears fuzzy.

With Zenith's FTM, the .28-millimeter-dot-pitch shadow mask is held flat behind the surface of the monitor under tension. The high tension completely eliminates the distortion caused by heating.

Leaps Off the Screen

Because the shadow mask of the ZCM-1490 is flat, the display tube can also be perfectly flat. This is in startling contrast to the convex shape of a normal monitor screen, which, goes out of its way to locate sources of reflection and direct them at your eyes. Thus the ZCM-1490 reduces the area of reflection, as well as eliminating distortion caused by changing your viewing angle. Couple this with an advanced antiglare coating, and you've created the medium for an image that leaps off the screen.

Zenith says that the flat-tension monitor can handle up to eight times the power of a normal shadow mask. That's good, because upping the power allows Zenith to equip the monitor with a black, nearly opaque faceplate that filters out 70 percent of the outgoing light. This technique creates a high-contrast image. The bad news is that it generates heat. So much heat, in fact, that the unit comes equipped with its own cooling fan and smells of burning plastic for the first few days.

The analog monitor comes with a 15-pin connector that is compatible with IBM's PS/2 series of computers. It is capable of displaying up to 640 by 480 pixels and is designed to work with IBM's VGA or Zenith's Z-449 video card for the standard PC bus; it can support emulation of the EGA, CGA, and MDA video standards. Automatic vertical sizing (350, 400, and 480 lines) helps keep the vertical size of the image constant, despite the image type. Zenith has said that it will switch to the VGA standard across its line of personal computers.

At 43 pounds, the display is no lightweight. It sports brightness and contrast adjustments on the top of the monitor. The power switch, although on the back, is easy for fingers to find when you're fumbling around.

The power cable is a standard, detachable type, but the video feed is something entirely different. Hard-wired to the monitor, the cable is thick enough to pass for armored cable and makes the IBM PS/2 monitor cable look like a piece of kite string. So while you won't have to worry about breaking the wires in this cable by bending it too tightly, plan on rerouting your other cables to fit around it.

Now that I've sampled the world of FTM, you couldn't get me to go back to a "normal" monitor. With the most phenomenal color images available on the PC today, plus a price that is easily competitive both with IBM's PS/2 monitors and with the popular multifrequency monitors, the Zenith ZCM-1490 is the one to own. PC

Because the shadow mask of the ZCM-1490 is flat, the display tube can also be perfectly flat. This is in startling contrast to the convex shape of a normal monitor screen.



Zenith Data Systems' 43-pound ZCM-1490 analog display monitor holds its shadow mask (a perforated metal screen) perfectly flat behind the display tube to reduce the amount of glare. A black, nearly opaque faceplate allows for a high-contrast image.

PC MAGAZINE FACT FILE

Zenith ZCM-1490
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(800) 842-9000
List Price: $999; Z-449 VGA adapter for PCs, $599.
Requires: VGA adapter.
In Short: Offers the most brilliant image available on a PC today, thanks to the innovative use of flat-screen technology.

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- 1.2 Megabyte Floppy Drive.
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- Full AT Compatability.
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EGA system add $500

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EGA system add $500

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- 1.2 Megabyte Floppy Drive.
- Mono/Graphics Card.
- TTL Amber Monitor with Tilt and Swivel Base.
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- 200 Watt Power Supply.
- Set-up built into Motherboard.

Total $1,395.

Same model with 40 megabyte drive $1,895

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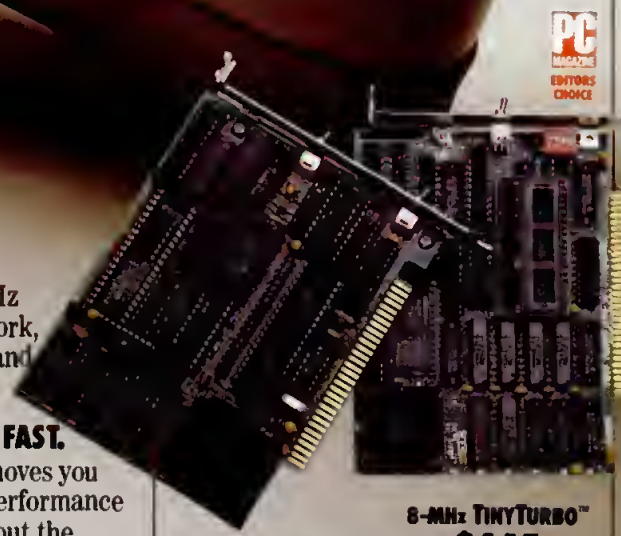
The TwinTurbo 12 is compatible with all application programs for the IBM PC, XT and 8088-based clones—even 8-MHz imports. As well as network, multifunction, graphics and other add-on cards.

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FACT FILE

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List Price: General Ledger, Accounts Receivable, Accounts Payable, $795 each. Also available, seven other modules, single-user run-time version, $99; multiuser run-time version (which makes all other modules multiversion), $495.
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CIRCLE 263 ON READER SERVICE CARD

NEW ON THE MARKET

Connectivity Boards for the IBM PS/2 Bus Link PCs to IBM System 3X Minicomputers

IDEAssociates has introduced boards to deliver on one of the Micro Channel's main promises: connectivity to midrange and mainframe systems. The IDEAcomm 5251/MC ($895 with software) connects Micro Channel PS/2s to System 3X minis or remote controllers via twinax cable. The IDEAcomm 5250/Remote MC ($795) connects the IBM PS/2 Models 50, 60, and 80 to 3X systems via a synchronous modem.

The 5251/MC allows PCs to emulate the IBM 3180, 5251 Model 11, 5291, and 5291 Model 2 terminals, and it can be used with color or monochrome monitors.

Up to four concurrent host sessions are supported. The 5250/Remote MC supports nine concurrent host sessions, which can be any combination of display and printer.

The card offers 3180 emulation with 132-column support, as well as emulation of the IBM 5251 Model 11, 5291, and 5292 Model 1 terminals.

Both boards also allow PC parallel or serial printers to emulate IBM 5334, 5225, and 5226 printers, in addition to the 5219 letter quality printers.

List Price: IDEAcomm 5251/MC, $895. IDEAcomm 5250/Remote MC, $795. **Requires:** Micro Channel PC. IDEAssociates Inc., 29 Dunham Rd., Billerica, MA 01821.; (617) 663-6878.

CIRCLE **408** ON READER SERVICE CARD



IBM's Micro Channel promises a smoother relationship between micros and larger systems. The $895 IDEAcomm 5251/MC connects PS/2s to System 3X minis.

Color and Monochrome Monitors Furnish PS/2 Users with Alternatives

IBM's shift to analog monitors and a new graphics standard has added VGA to the thick alphabet soup of graphics standards. New monitors from **Amdek Corp.** offer an alternative to Big Blue's standard equipment.

The Monitor/432 ($245) monochrome and the Monitor/732 ($625) color monitors offer three resolution modes. They are compatible with the 640- by 480-pixel VGA standard, the 640- by 400-pixel CGA standard (scan doubled), and the 640- by 350-pixel EGA standard.

Like IBM's PS/2 monitors, the Amdek screens accept an analog video input signal and feature a horizontal scan frequency of 31.48 kHz. Vertical scan frequencies are 50, 60, and 70 Hz. Amdek says the Monitor/432 and Monitor/732 work with the PS/2 Models 50, 60, and 80.

The monochrome unit has a 14-inch screen, measured diagonally, which is larger than IBM's 12-inch monochrome PS/2 offering. The Monitor/432 comes with a choice of paper white or amber phosphor. Amdek says the Monitor/432 is the only amber-phosphor VGA monitor available.

The color Monitor/732 has a 12-inch antiglare screen and a dot pitch of .28 mm.

List Price: Monitor/432, $245; Monitor/732, $625.

Requires: VGA graphics. Amdek Corp., 1901 Zanker Rd., San Jose, CA 95112; (408) 436-8570.

CIRCLE **412** ON READER SERVICE CARD



New analog color ($625) and monochrome ($245) monitors from Amdek offer users an alternative to IBM's PS/2 displays.

PC-to-Mainframe Link For Lotus 1-2-3 Routes Data into Spreadsheets

You can capture mainframe data and place it directly into a Lotus spreadsheet with *4-5-6 Link*, a memory-resident utility from **Intex Solutions.** The $199 program is designed for spreadsheet users who need to select data from many different sources on a mainframe, Intex says.

When *Link* is communicating with a mainframe, the PC emulates a 3278 terminal. You select data to be downloaded from a mainframe screen by pointing. A keystroke imports the data into a spreadsheet. Transfer of multiple screens can be automated.

List Price: *4-5-6 Link*, $199.

Requires: 40K RAM above *1-2-3* memory requirement; *1-2-3*, Release 1A or later; DOS 2.0 or later. Not copy protected. Intex Solutions Inc., 568 Washington St., Wellesley, MA 02181; (617) 431-1063.

CIRCLE **423** ON READER SERVICE CARD

$10-$14 Data Interrupt Eliminators Stop Data Loss Over Standard Telephone Lines

When modems and phones use the same line, there is the chance someone will pick up an extension during transmission, with resultant data loss.

The Data Interrupt Eliminator, from **Data Spec**, is designed to eliminate this problem. One of these inexpensive devices ($9.95 to $13.95, depending on the model) is placed in-line at each extension or modem sharing the same line. The Data Interrupt Eliminator sends signals to the other Eliminators that electronically turn off any instrument on the line, except for the first one activated.

List Price: Data Interrupt Eliminator Model MP600, standalone in-line unit, $9.95; Model MP620 surface-mounted modular version, $10.25; Model MP630, which replaces telephone modular wallplate, $13.95; Model MP640 for wall-mounted phone, $11.95. Data Spec, 20120 Plummer St., P.O. Box 4029, Chatsworth, CA 91313; (818) 701-5848.

CIRCLE **410** ON READER SERVICE CARD



Data Spec's Data Interrupt Eliminator (from $9.95) locks out phone extensions during modem transfers in order to prevent inadvertent data loss.

by Jonathan Matzkin



Portability makes today's laptops prime theft targets. The PC Guardian Model 1000 provides a measure of security in airports and other remote locations.

Guardian Model 1000 Secures Laptops with A 6-foot Steel Cable

Laptop PCs are easy to carry, which is good. But they are also easy to steal, which is definitely not good. The PC Guardian Model 1000, from **Micro Security Devices**, is intended to provide security for laptops and portables on the go.

The Model 1000's 4- by 4- by ½-inch steel housing attaches to the PC. It contains a retractable 6-foot steel cable that locks around any convenient stationary object. The device weighs approximately 1 pound, according to Micro Security Devices.

List Price: PC Guardian Model 1000, $99.95. Micro Security Devices, 118 Alto St., San Rafael, CA 94901; (415) 459-0190.

CIRCLE **409** ON READER SERVICE CARD

Emerald Backup Unit Stores 2 Gigabytes on A Single Tape Cassette

Emerald Systems has announced a tape backup system that has up to 2.2 gigabytes of storage on a tape cassette the size of a pocket calculator.

The $6,995 VAST device is intended for use in systems such as LAN servers where large-capacity hard disks are employed.

Emerald says that extremely high recording density is possible with helical scan recording techniques, which are also fast. The VAST device backs up disks to tape at a rate of up to 15 megabytes per minute, according to Emerald.

The external subsystem measures 16 by 14 by 8 inches and interfaces to the PC through a 60-inch cable and an SCSI controller board. Five-packs of VAST cassettes are available in 250-megabyte ($250), 500-megabyte ($275), 1-gigabyte ($300), and 2.2-gigabyte ($325) capacities.

List Price: VAST, $6,995; Five 250-Mbyte cassettes, $250; Five 500-Mbyte cassettes, $275; Five 1-gigabyte cassettes, $300; Five 2.2-gigabyte cassettes, $325.
Requires: Hard disk drive, expansion slot, DOS 3.0 or later. Emerald Systems Corp., 4757 Morena Blvd., San Diego, CA 92117; (619) 270-1994.

CIRCLE **411** ON READER SERVICE CARD

A $50 LIM Simulation Utility From Vericomp Works In Compatibles

If you've been wondering what to do with the extra 384K bytes of RAM on the motherboard of your PS/2 Model 50 or 60, here's a suggestion.

SoftBytes, a $49.95 utility from **Vericomp**, will let you use that extra memory as Lotus/Intel/Microsoft expanded memory, with no hardware additions at all. The EMS (LIM 3.2) simulator is a significant upgrade to Vericomp's earlier *MicroVMS* virtual expanded memory software.

Vericomp says that *SoftBytes* provides the functionality of up to four expanded memory boards. Since the program can use a disk device or extended memory for storage of LIM expanded memory data, it will run on just about any IBM-compatible PC, Vericomp claims.

List Price: *SoftBytes*, $49.95.
Requires: 70K RAM, either extended memory or hard disk drive, DOS 2.0 or later. Not copy protected. Vericomp, 8825 Aero Dr., #210, San Diego, CA 92123; (619) 277-0400.

CIRCLE **422** ON READER SERVICE CARD

HOT PROSPECT

Microsoft Combines Ease-of-Use With Integration In Works Package

Although recent announcements have focused on *OS/2*, *Windows* 2.0 and other esoterica, **Microsoft** hasn't been ignoring the small business and home user. *Microsoft Works* will bring to the PC the same ease of use that Microsoft's integrated software brought to the Apple, the company says.

The $195 package will offer word processing, a spreadsheet with graphics, a database with reporting capabilities, and communications.

Though *Microsoft Works* is for neophytes, it offers some sophisticated capabilities. Users can mix text and graphics in a document, and can select fonts. Multiple documents of different types—spreadsheets and letters, for example—can be opened simultaneously.

Macros are available across all four modules, and the modules are linked by a consistent user interface and pull-down menus.

Microsoft Works offers file compatibility with more-advanced products such as *1-2-3* and *Microsoft Word*, so you can upgrade painlessly.

List Price: *Microsoft Works*, $195.
Requires: 384K RAM; one 720K-byte or two 360K-byte floppy disk drives or a hard disk drive; CGA, EGA, or Hercules graphics card; DOS 2.0 or later. Not copy protected. Microsoft Corp., 16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717; (206) 882-8080.

CIRCLE **405** ON READER SERVICE CARD



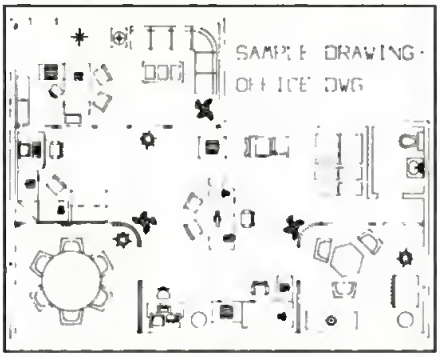
Microsoft Works *has pull-down menus throughout its four basic software modules.*

PC UPDATE

edited by Peggy Gavan

Generic CADD, FirstCADD, Generic 3-D

Generic Software has added two utilities to its CADD series. ***PenPlot***, priced at $49.95, enables users of *FirstCADD*, *Generic CADD*, and *Generic 3-D* to plot their drawings on more than 36 plotters. In addition, *PenPlot* supports the Hewlett-Packard Graphics Language.



Generic CADD *users can now plot their drawings on more than 36 plotters using Generic's* PenPlot *utility.*

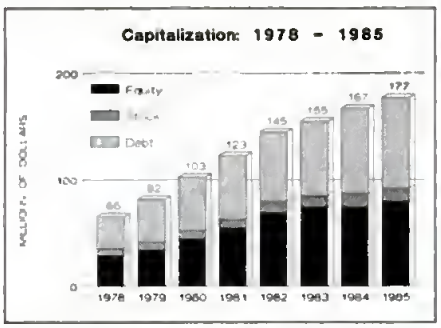
Desktop Publishing, also priced at $49.95, allows users to put mechanical drawings into desktop publishing environments that support the PostScript or bit-image formats. Generic Software, Redmond, Wash.; (206) 885-5307.

Open Access, Version 2.05

Open Access, Version 2.05, adds graphics drivers for IBM PS/2s, LIM expanded memory support, and support for 8087 and 80287 math coprocessor chips. Registered single or network users of *Open Access II* can upgrade for $50. Software Products International, San Diego, Calif.; (619) 450-1526.

SlideWrite Plus, Version 2.0

SlideWrite Plus, Version 2.0, has an enhanced graphics module with engineering and scientific charting features, mouse support, and support for up to 200 charts or graphs on one page.



SlideWrite Plus. *Version 2.0, has more than 100 new graphs and draw features, including 3-D bar graphs.*

SlideWrite Plus is priced at $345; upgrades are $95 for registered users. Advanced Graphics Software, Sunnyvale, Calif.; (408) 749-8620.

Harvard Professional Publisher

Software Publishing Corp. has discontinued its ***Harvard Professional Publisher*** desktop publishing package. Customers who have already purchased the program can trade their current package for copies of *PFS:First Publisher* (regularly $99) and *Harvard Graphics* ($395). Software Publishing Corp., Mountain View, Calif.; (415) 962-8910.

X-Tree, X-Tree Pro

Executive Systems has released ***X-Tree Pro***, a faster and more powerful version of ***X-Tree*** for large hard-disk systems. The new version runs up to seven times faster than the original product and offers increased file and directory capacity. Current owners of *X-Tree* can upgrade for $30 until December 31, and for $45 thereafter. Executive Systems Inc., Sherman Oaks, Calif.; (818) 990-3457.

StarLAN 2.0

AT&T's ***StarLAN*** networking software, Version 2.0, adds an enhanced implementation of the NETBIOS interface to improve compatibility with IBM LANs and compatibles. The new version, priced at $125, also has improved installation and menu facilities. Upgrade kits are available to registered users for $30. AT&T, Morristown, N.J.; (201) 898-3278.

IN BRIEF

WordTech Systems now has a free electronic bulletin board to assist registered users of ***dBXL***, ***Quicksilver***, ***Networker***, and ***MS-DOS Libraries***. Users can access the bulletin board by dialing (415) 254-1141. WordTech, Orinda, Calif.; (415) 254-0900 . . . ***Relay Gold*** and ***Relay Silver*** now support 3101 terminal emulation. Current users can download the feature from VM Personal Computing's bulletin board at (203) 798-3921 (1,200 bits per second) or (203) 798-3913 (2,400 bps) . . . Master Control Systems' ***LinkMaster***, originally offered at no cost, is now priced at $179.95. The program has been upgraded with enhanced features. Master Control Systems, Chesapeake, Va.; (804) 420-3627.

PS/2 WATCH

3 Plus, Version 1.2.1

3Com Corp. has released a new version of its *3 Plus* software that supports all IBM PS/2 computers as network workstations and servers. Version 1.2.1, available for $1,050 per server, adds NETBIOS enhancements and drivers for IBM's Token-Ring Network/Micro Channel Architecture. Registered users of Versions 1.1 and 1.2 can upgrade for $30. 3Com Corp., Santa Clara, Calif.; (408) 562-6400.

Paradox: The perfect relational database manager for both novices and advanced users

Paradox® is so technically advanced that it's easy to use.

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> "Paradox is, indeed a unique blend of a user-friendly relational database with a highly sophisticated and powerful programming environment."
>
> *Rusel DeMaria, PC Week*

> "We find Paradox preferable to every database system we've encountered so far, including dBASE III PLUS, for both everyday use and application development."
>
> *Jay Alperson & Steve King*
> *Data Based Advisor*

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That's not a contradiction.
That's innovation.

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PARADOX

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The merger of Ansa with Borland is subject to approval of shareholders and regulatory authorities. BI 1160

Show Partner F/X: Total Control Over Your Screen Presentations

PC HANDS ON

BY GUS VENDITTO

In 1986 *Show Partner* brought screen presentations to life. This year the next generation of *Show Partner*, *F/X*, makes presentations get up and dance.

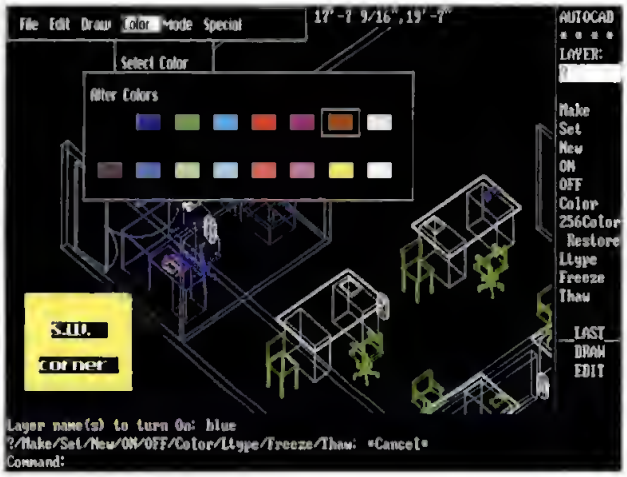
Running under one of the most intelligent interfaces around, *Show Partner F/X*, from Brightbill-Roberts and Co., puts virtually all of your PC's graphics potential right in the palm of your hand. Once you capture a screen you're able to paint on it, change the screen mode (for graphics), and create a structured presentation that can run as long as you like.

Virtually all of the program's features have been expanded. The original let you string screens together using Wipe, Weave, or Fade effects. *F/X* provides Drip (each image rolls down, trailed by a stream of pixels); Spiral (a new screen unrolls itself like a spinning pinwheel); and Shake (the full image bounces around for a couple of seconds after it appears). A font editor now lets you create characters in either 640-by-200 or 320-by-200 screen modes. And 10 more fonts were added, for a total of 30.

Crystal-clear logic governs this point-and-shoot package. A script language allows you to create very elaborate shows, adding sound effects and letting you use the time one image is displayed to load several others into memory. Screens can scroll text read from a disk file, so elaborate scripts don't need revision to accommodate editing changes.

The best effect you get from using *F/X* is the feeling of control you have over your PC. Instant screen mode changes let you determine whether an image is better served by more color or more definition.

The most spectacular effect is object animation. A graphic image can be loaded into memory, laid over another full-screen image, and made to roam around the screen on a course that's either preset or created by the viewer during the show.



Easy access to the color palette is typical of Show Partner F/X*'s intelligent interface.*

The font editor and paint program don't have the resources of dedicated packages, but *F/X* can use fonts from other sources (including *PC Paintbrush* and Hercules RAM fonts). *F/X* gets points for lots of little things: it polls the hardware for graphics information, instead of relying on the user, and it was the first program to utilize VGA graphics fully.

The program's usefulness is limited to those who produce screen presentations, but it makes that job an absolute pleasure. It also makes you wish Brightbill-Roberts were designing more software. PC

PC MAGAZINE FACT FILE

Show Partner F/X
Brightbill-Roberts and Co. Ltd.
120 E. Washington St.
Syracuse, NY 13202
(315) 474-3400
List Price: $350; upgrade, $300.
Requires: 320K RAM; one disk drive; CGA, EGA, VGA, MCGA, or Hercules graphics; DOS 2.0 or later.
In Short: A powerful tool for customizing on-screen presentations. Not copy protected.

CIRCLE 405 ON READER SERVICE CARD

dBASE Tips: Lots of Ideas, Little Insight

PC BOOK REVIEW

BY WILLIAM A. TAYLOR

George Tsu-der Chou wrote *dBASE III Plus—Tips, Tricks, and Traps* to help you increase your efficiency in using *dBASE III*. The result is disappointing. Mr. Chou knows *dBASE* well but can't seem to convey a coherent picture of what *dBASE* does.

The tips are useful, but no more so than the tips in the *dBASE III* manual. The lists of *dBASE* commands and functions do not include enough explanation of how to use functions to replace the user manual. For example, page 194 has an example showing how STR converts numeric data to characters, but there is no explanation of what the STR parameters do—you need the *dBASE* manual for that. On page 195, you are warned about the wrong way to order records by date without being told about the right way.

One of the most confusing concepts for *dBASE* beginners is the relationships between the different kinds of *dBASE* files. Page 141 lists eight file types *without* explaining how these files interact.

The best way to introduce *dBASE* is to provide an aerial photo of the forest, not introduce individual trees. The most important idea behind *dBASE* is that you can think of a database as a series of tables that can be related to one another by their contents. This fundamental concept is not even mentioned. There are many suggestions about how to use index files—and dire warnings of the consequences of using them wrong—without any explanation of what indexes *are*.

Omission of the overview means that the book is not very helpful. It's neither fish nor fowl—too thick to be a handy supplement to the user manual, but without enough detail to replace it.

Clearly, a lot of work went into this. It should have been very useful. I grieve. PC

PC MAGAZINE FACT FILE

dBASE III Plus—Tips, Tricks, and Traps
By George Tsu-der Chou
Que Corp.
P.O. Box 50507
Indianapolis, IN 46250
(800) 428-5331
ISBN: 0-88022-286-7
List Price: $19.95
In Short: Neither an overview nor a how-to; something in the middle and none too valuable.

CIRCLE 388 ON READER SERVICE CARD

Borland's new Turbo C: The most powerful optimizing compiler ever

Our new Turbo C* generates fast, tight, production-quality code at compilation speeds of more than 13,000* lines a minute!

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Michael Abrash, Programmer's Journal"

Join more than 100,000 Turbo C enthusiasts. Get your copy of Turbo C today!

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CIRCLE 137 ON READER SERVICE CARD

Technical Specifications

- Compiler: One-pass optimizing compiler generating linkable object modules. Included is Borland's high-performance Turbo Linker.* The object module is compatible with the PC-DOS linker. Supports tiny, small, compact, medium, large, and huge memory model libraries. Can mix models with near and far pointers. Includes floating point emulator (utilizes 8087/80287 if installed).
- Interactive Editor: The system includes a powerful, interactive full-screen text editor. If the compiler detects an error, the editor automatically positions the cursor appropriately in the source code.
- Development Environment: A powerful "Make" is included so that managing Turbo C program development is highly efficient. Also includes pull-down menus and windows.
- Links with relocatable object modules created using Borland's Turbo Prolog* into a single program.
- Inline assembly code.
- Loop optimizations.
- Register variables.
- ANSI C compatible.
- Start-up routine source code included.
- Both command line and integrated environment versions included.
- License to the source code for Run-time Library available

Sieve benchmark

	Turbo C	Microsoft® C
Compile time	2.4	13.51
Compile and link time	4.1	18.13
Execution time	3.95	5.93
Object code size	239	249
Execution size	5748	7136
Price	$99.95	$450.00

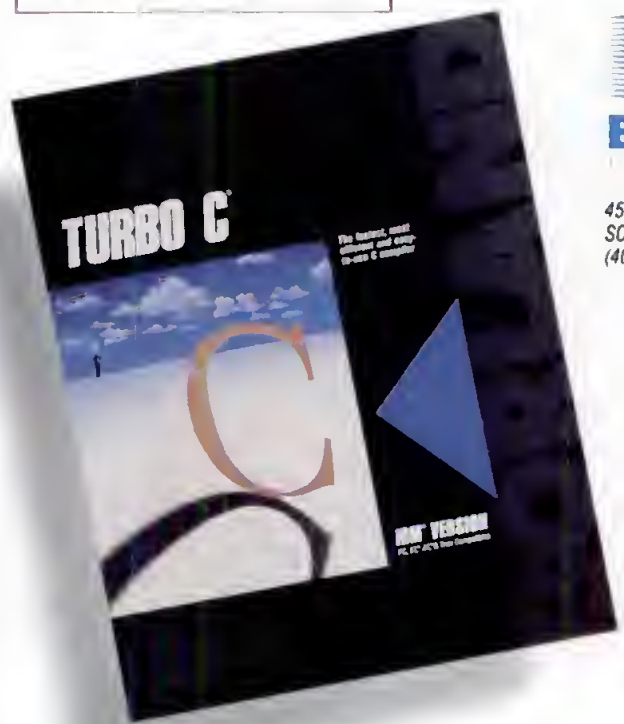
*Benchmark run on an IBM PS/2 Model 60 using Turbo C version 1.0 and the Turbo Linker version 1.0; Microsoft C version 4.0 and the MS overlay linker version 3.51

Minimum system requirements: IBM PC, XT, AT, PS/2 and true compatibles. PC-DOS (MS-DOS) 2.0 or later. 384K

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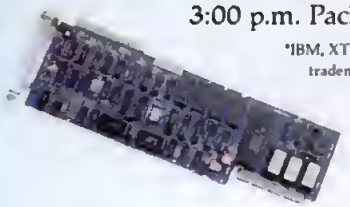
Plug compatible with the IBM* PC, XT and AT, the KB 3270/PC was developed to work in conjunction with micro-to-mainframe emulation packages from vendors such as DCA (IRMA™), CXI, FORTE' and ATTACHMATE.



By providing 122 keys including 24 function keys, the keyboard allows for easy and efficient operation resulting in more operator productivity.

It's another input solution from Key Tronic, the world's largest independent manufacturer of full travel keyboards, and a supplier of a full line of integrated input devices.

For more information about the KB 3270/PC, see your Key Tronic dealer . . . or call us toll-free at **1-800-262-6006.** (7:00 a.m. to 3:00 p.m. Pacific Time)



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CIRCLE 244 ON READER SERVICE CARD

COMMUNIQUES

edited by Bill Howard

Amazing Facts I

"Bill Gates . . . was on hand to support the Unix/Xenix merged operating system, which combines Xenix—Microsoft's version of Unix, which runs under the MS-DOS operating system—with AT&T's Unix."

—InformationWEEK, *September 7, 1987*

Amazing Facts II

"dBASE . . . is the database of choice. [F]or the small amount they are used, spreadsheet packages are evenly divided between Computer Associates' SuperCalc and Lotus Development Corp.'s 1-2-3."

—MIS Week, *August 31, 1987*

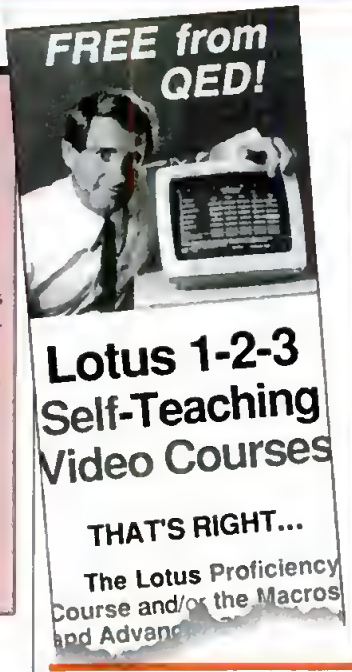
Amazing Facts III

"The [Datavue] Spark . . . is not as complete, lacking a separate numeric pad"

—InfoWorld, *September 7, 1987, page 54*

"The clear winner in the value category is the Datavue Spark. The keyboard may be a bit annoying at first, but it does have a separate numeric keypad."

—Page 61



Lesson 1 of this QED Information Sciences, Inc., tutorial will be: What's the moving bar menu doing on the bottom?

We'll Take This One Pass-Fail

Word Processing & Microcomputer Curse

—Headline, Office Automation Education Centres ad, Calgary Herald, *August 17, 1987*

Why They Call It A Smart Buffer

"Our new 256K Smart Printer Buffer allows you to use your printer while it's printing."

—Ultimate Computer Supplies (Lakewood, N.J.) catalog

Formerly Owned by James Brown, Who Missed Not Having a Numeric Keypad

"Datavue Spark laptop, 650K, Supertwist LCD, R&B output . . . $1,295."

—Dr. PC Inc. ad, Dallas Morning News, *September 5, 1987*

Which Datavue Calls the R&B Port

IBM PC XT compatible, 640k, 20 mg hard disk, with Tatung monitor and board, graphics, game card, 2 parallel and 2 stereo ports, printer adapter, math chip, miscellaneous software, $1,700 or best offer. xxx-xxxx.

—The Ottawa Citizen, *September 10, 1987*

Quality Control

"And with more than 500,000 mice on the market, less than .005% of which have experienced no problems at all, we are confident that our new [lifetime warranty] policy is a good one."

—Microsoft Mouse press release



Run-time version not pictured: full-page ad for Beall's department store in the St. Petersburg *(Fla.)* Times.



Help deflate the industry's stuffed shirts and you could win a T-shirt (and $50). Submit entries to: Communiqués, PC Magazine, *One Park Avenue, New York, NY 10016, or MCI Mail 157-9301. Print your name clearly, include your T-shirt size, and if you send a newspaper or magazine clipping, be sure to identify the name and publication date.*

Communiqués winners this issue: Michael Hughes (Basic Software), Donald Smith (QED 123 tutorial), Brian Kergan (WP curse), Alan Lustiger (Unix under MS-DOS), Patricia Phelps (evenly divided spreadsheets), Charlie Cohon (Spark), Tom Davis (R&B output), Peter Menyasz (stereo port), Charles Sluskonis (smart buffer), Jim Seymour (Microsoft Mouse).

Illustration, A. Bacall

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 16-bit 2 MB extended or expanded memory per card and up to 4 cards per PC/AT. Software supported: DESQVIEW, Framework, Symphony and Lotus 1-2-3. Board comes with O.K. **$129.00**
- **EEMS RAM CARD FOR 386 SYSTEM**
 32-bit 2 MB extended memory card for the 386 AT system board. **$199.00**
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- **SERIAL II CARD**
 One RS-232C osynchronous communication interfoce. Second serial port option. **$44.00**
- **300/1200 BAUD MODEM**
 Halfsize internal Hayes compatible. Auto diol/Auto answer. Touchtone/pulse dialing. **$89.00**
- **PC OPTICAL MOUSE**
 Dr. HALO software included. 200 dots/inch. **$109.00**
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 Real time clock/calendar for PC/XT. **$39.00**
- **MS DOS 3.2 w/GW BASIC** **$79.00**

XENIX MULTI-TERMINAL

- Microprocessor-based intelligent terminal controller. Z-80B CPU.
- 16 KB dual port RAM, 8 KB local RAM
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Accelerates your PC/XT to faster speeds than AT. 80286/8088 mode switchable. Clock speed: 10 MHz. 8 KB of high speed 0 wait state cache memory. Support for 80287 running at 6 or 10 MHz. **$329.00**

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Seagate 251 40 MB ½ Ht	$559.00
Seagate 4038 30 MB Full Ht	$589.00
Seagate 4051 40 MB Full Ht	$645.00

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KX-P1091i 160 CPS Dot Mat	$259.00
KX-P1092i 240 CPS Dot Mat	$339.00
KX-P1595 240 CPS Dot Mat	$459.00

MONITORS

SAMSUNG

MD 1277G Mono 12" Amber	$99.00
MD 1252G Mono 12" Amber w/Tilt & Swivel bose	$109.00

THOMSON

4120 CGA RGB 14" Color	$315.00
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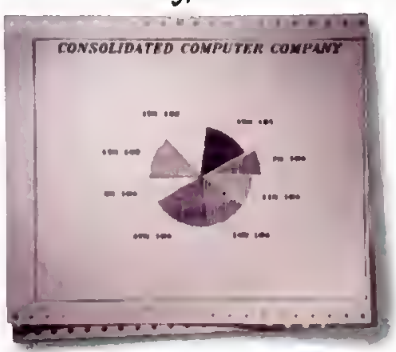
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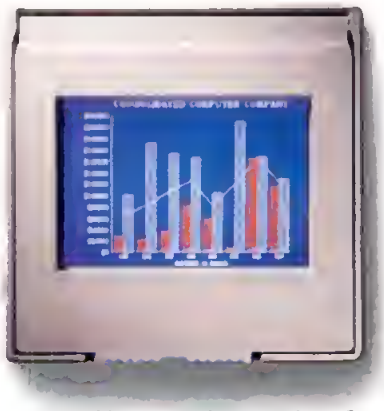
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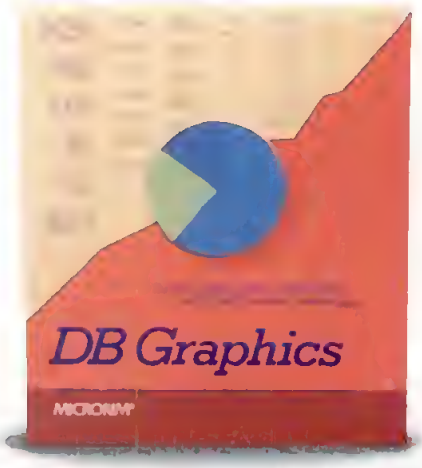
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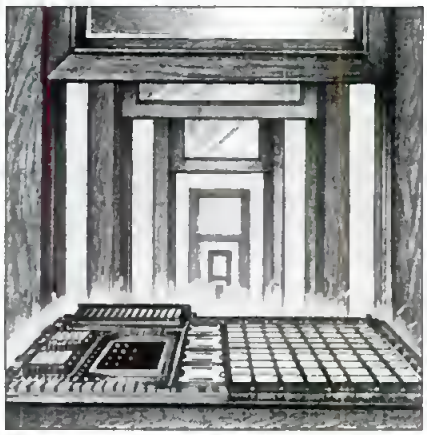
In the year of the strategic alliance, tactics count more than ever. AST's support of the new EMS spec makes life simpler for users and programmers. What does it mean for OS/2?

Remember the memory wars? Lotus and Intel joined forces to solve Lotus's problem of fitting really big spreadsheets into the PC. The solution was an old one for computers, but new to the PC: bank switching. The basic technique uses one area of a computer's memory as a window into a much larger area. The actual implementation is rather tricky and requires standards so that the operating system, applications programs, and the bank-switched memory get along together. Lotus and Intel moved quickly and more or less coerced Microsoft and the rest of the industry into supporting the nascent standard. Thus was born EMS, the expanded memory specification.

A STEP BEYOND EMS Some hardware and software types thought that spec didn't go far enough. They responded with the enhanced expanded memory specification. Spearheaded by AST, manufacturers built expanded memory boards that gave users a true superset of the Lotus/Intel/Microsoft spec. EEMS used much larger pages, which made for faster context switching. Its driver did a better job of tracking multiple allocations of expanded memory. It also had additional hardware on the memory card to allow programs to execute from EEMS, saving precious space in the lower 640K. Quarterdeck Office Systems built a major programming effort, *DESQview*, around EEMS. With it, users can multitask existing DOS applications. Many popular applications can actually share the screen in multiple windows.

EMS was never intended to hold executable code. Remember, it was designed to solve a specific problem for Lotus. But you can't keep a clever programmer down. Bob Bierman of Living Videotext pored over the EMS spec and found a way to run code from expanded memory. The result was *Ready!*, the innovative pop-up outline processor that is still considered by many to be the ideal companion to word processors that don't have outliners. It shouldn't have required a stroke of genius, though, to develop utility software that hides in EMS. We needed a spec that would make it easy for anyone to do it.

Then, when Microsoft laid the groundwork for *Windows* 2.0, its designers decided to incorporate the benefits of EEMS. *Windows*, with its nonpreemptive multitasking (a background application only gets CPU cycles if it needs to write to the screen), could use a shot in the arm from EEMS's faster context switching. It could also benefit from EEMS's greater ease in running code from expanded memory. EMS, it appeared, would provide some benefit to *Windows* 2.0, but EEMS would be noticeably superior.



This turn of events put the pressure on Intel and confirmed the point that AST was trying to make in the first place: if there is going to be an expanded memory standard, it should be a humdinger.

EMS UNCHAINED Fortunately, there was a solution. Intel saw the writing on the wall and geared up its software department for a major overhaul of EMS. Version 4.0, announced in August, incorporates all the goodies software designers have been looking for. It makes it easy for code to execute from expanded memory. It allows multiple programs to share expanded memory without a bunch of defensive programming. It extends the programmer's playground by simulating far jumps and far calls in the EMS 4.0 driver.

The result is a raising of the limits. The 640K barrier doesn't loom quite so large. The number and size of programs ceases to be a limitation. Terminate-and-stay-resident programs written for EMS 4.0 now take up a tiny fraction of the space they used to. And it's still good old DOS. No new operating system to learn, no messy floors to mop.

AST is so pleased with the outcome that it has buried the hatchet—and EEMS. It now supports EMS 4.0 as the official memory spec. The marketing battle with Intel was an unproductive, distracting affair, from which neither company benefited. After all, both are in the hardware busi-

Illustration: John Brenkey

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■ EDITOR'S SCREEN

ness, not software. AST's version of the driver, while fully software compatible, will realize a small performance advantage when running on the AST hardware. You still need EEMS hardware, by the way, to run *DESQview*.

DESQview points the way to practical, widely supported multitasking under DOS. Both *Metro* and *SideKick Plus* offer management of pop-up utility software, complete with extensive operating-system-like services. For the user who doesn't require a graphics interface, they may suffice. Those who want to put a pretty face on it can use *Windows* 2.0. So just when you were beginning to think about leaving DOS for OS/2, there's a bunch of new options to consider.

HOT-KEY MULTITASKING But if you want real multitasking, OS/2 is still the preferred solution. The kind of non-preemptive or "hot-key" multitasking that DOS can offer is simply not in the same league with OS/2. The round-robin, priority-sensitive multitasking that OS/2 offers is entirely absent from DOS. OS/2 knows some other good tricks, too. It can spawn child tasks and manage interprocess communications.

Best of all, from many a programmer's point of view, OS/2 runs in protected mode. This gives system designers full access to the PC AT's 16 megabytes, without recourse to programming tricks. (Nothing in OS/2 precludes them from using EMS, too. In fact, they probably should if they want to build systems with maximum performance and flexibility.)

Already some quarters are touting EMS 4.0 as the salvation of DOS. With the revamped EMS, the story goes, you don't need *Windows*, OS/2, or *DESQview*. You just put everything up in memory and live happily ever after. That just isn't true. You need some kind of environment manager to keep track of it all or you succumb to hot-key madness. Lotus has said that *1-2-3*, Release 3, under DOS and EMS 4.0 is the equal of Release 3 under OS/2. That's fine only if you take the statement at face value. You get into trouble when you try to read into it.

What is true is that EMS 4.0 is real progress. And it's put an end to the memory wars.

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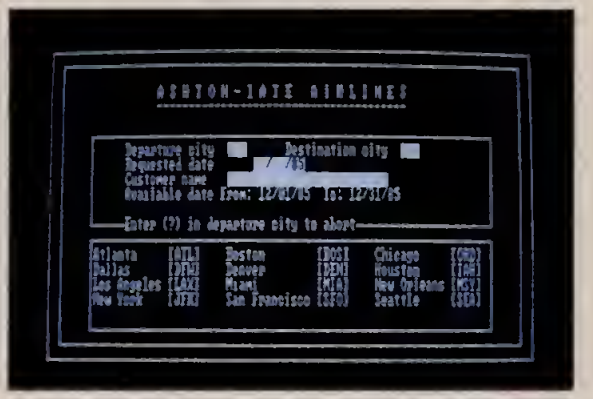
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■ JOHN C. DVORAK

MARKETING, MARKETING, MARKETING



Software companies can learn some marketing tricks from other businesses that will make their products and their advertising more exciting.

Every so often it happens. Someone develops useful or entertaining software that you want to own but can't because no publisher will publish it. "It doesn't meet our standards," they say. Why don't they simply do what the wineries do and bring out a "second label" for software not worthy of the first-label prestige? Lotus could have Flower Software, for example. This is an idea whose time has come. It turns out that we are long on products and short on ways to market the products.

The fact is that there are plenty of good marketing ideas in other industries that we're not using in the personal computer business. The key is to figure out what industries have parallel problems and copy their tried-and-true techniques. The wine business with its second label is a perfect example.

OLD WINE IN NEW BOTTLES Some ideas have been stumbled upon through trial and error. Many software companies, for example, are using an old technique in the wine business and don't even know it. When a winery constantly has lagging sales, usually due to an inferior product, the winery changes the label in hopes that people will think there is an improvement in the wine. In this instance the second label of a product would be genuinely inferior. At the extreme: marketing is the name of the game. Forget about the quality of the wine *or* the software.

So what other industries, besides wine selling, parallel some of the problems we see in this business? Well, I think the cereal business is one. Let's face it, there is little difference between Post Toasties and Kellogg's Corn Flakes. So they do things like make the box extra large, use fancy graphics, and make dubious claims. Sound familiar? Yes, we've stumbled onto some of the ideas but not the best ones. One that is missing from the software industry is the cartoon spokesman—a Tony the Tiger of software. "*Word Purrrrrfect* is Grrrrrrreat!"

ANIMATED SALESMEN I think cartoon characters selling software and saying outlandish things would add spice to the business. "Silly rabbit. *Crosstalk* isn't for rabbits! It's for adults." And surely we could make hay with a Captain Crunch–type character in the software industry. My theory: one Saturday morning spent in front of the TV watching cartoons will do wonders for a marketing man.

Another industry in which competition is stiff and products are not dissimilar is the soap business. Here there is an overlooked gold mine of ideas.



Illustration: John Breakey

Let's not forget the classic soap commercials with a big fist coming out of a washer or the ring-around-the-collar dilemma. Software can be sold the same way. I'd enjoy seeing a fist come from a CRT or watching a secretary moan about how long it takes to recalc a spreadsheet.

"What's wrong, Marge?"

"Oh, this spreadsheet takes forever to recalc. I don't know what to do. I have to have this report ready in an hour."

"Hey! You need *ReCalcCalc* with its superpowerful optimized recalc. It's built right in. You don't have to do a thing."

THE LATEST AND GREATEST Where the soap people really shine, though, is in promoting improvements in their company's products. We can do the same. Instead of releasing, say, Version 4.1 of *Microsoft Word*, thus admitting to bugs, the company should roll out NEW! IMPROVED! BETTER THAN EVER! *Microsoft Word*.

"Honey, do you have my copy of *Microsoft Word*?" asks the wife as she adjusts her oversized glasses.

"I don't have a copy of *Microsoft Word*. I gave up on it."

"What am I going to do?"

From behind his back he pulls out a copy of New and Improved *Microsoft Word*. "I use NEW *Microsoft Word*. It's better than ever!" They embrace and laugh.

I'll be laughing too.



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CIRCLE 271 ON READER SERVICE CARD

■ JOHN C. DVORAK

INSIDE TRACK

The End is near, thanks to the RISC microprocessor. You can kiss compatibility good-bye.

I Should Have Figured Out This Scenario When I First Got Wind of the Trend Over a Year Ago Dept.: If you haven't noticed, Sun Microsystems, a producer of high-end workstations, designed its own microprocessor. It's a reduced instruction set chip (RISC) that, when combined with some fancy software, becomes compatible with the Motorola 68000 family. Meanwhile, we hear that **others** are working on RISC chips too. Supposedly, **Apple** has such a project underway, and so too Atari and the secretive **Next Computer.** Everyone, it seems, is working on these things.

The reason: the big microprocessor manufacturers have made it clear that the next generations of processors will be sold through only one source—the manufacturer—and sold at a high price. Motorola has indicated a price of **$800 for the futuristic 68030 chip . . . take it or leave it.** Intel has already pulled the plug on the second source for its 80386, and we can expect the price to remain high and the price for its killer 80486 to be outrageous. So the smart money is saying we can do it ourselves, using the RISC concept of making a fast chip that relies on software to emulate other chips. RISC is chosen for its speed and because a debugged RISC chip can be designed and in production within a year.

Meanwhile, Intel and Motorola will have **chips languishing in the warehouse.** Motorola will lose its workstation market (it can kiss Sun good-bye tomorrow), and Intel will probably have only one customer: IBM. Even IBM may bail out if every other manufacturer goes to in-house designs. One-too-many executives in Armonk will ask, "Why can't we design our own chips for the personal computer? After all, everyone else is doing it."

So they will, too, and we will look back on the late 1980s as the **golden age of compatibility**, as the **Not Invented Here syndrome** turns designers away from compatibility to proprietary designs (as usual). One-too-many execs will say, "Why don't we add a special instruction to our chip? That way we can have Lotus make a unique version of *1-2-3* that only works on our machines and that we can sell directly and at a healthy profit! Everyone else is doing it."

The big losers in this sick scenario (which is a foregone and chilling conclusion) will be *guess who?* Intel and Motorola. I can imagine a world in which an Intel and a Motorola executive wander through some magical woods to find a goose that lays golden eggs. They watch the bird and comment on its unique ability. The Intel guy then says, "Gee, a goose like that. I'll bet it's good eating!" "Yeah," says the Motorola guy, "let's kill it and cook it. That way I won't have to go to the store today, either."

Enjoy the golden age of compatibility while you can.

And Now for Something Completely Different Dept.: So where are they getting these designers? Microsoft just released its new mouse, and as I look at it I'm reminded of a bar of Dove soap or a smallish **toilet for leprechauns.** No, it's a mouse. Was it designed by the promoters of the latest incarnation of the Microsoft logo? The logo has a little bite (get it? "byte") taken out of the "o" in *micro.* Other than that it's a boring logo. For this they pay money?

Well, at least I kind of like the mouse. It's nothing like the **Homely Award winner**—the new portable computer from HP, the Vectra CS—a no-backlighting, dual-floppy, 17½-pound clunker. **Probably the heaviest flat-panel machine ever made.** The company showed this thing at PC Expo, and it was just plain ugly. It looks like a huge 1950s-style cosmetics case. Gus Venditto, my editor at *PC Magazine*, said he expected to open it and find a Clairol hair dryer. Check it out if you like humor. When I closed and reopened the thing the weird floppy disk storage slots threw the disks all over the floor. Oh brother. Who consults with these guys?

I Like This Company Dept.: If you've ever considered designing and selling some software, you've probably wondered how you're going to organize the printing of documentation, shrink-wrapping, label printing, and other **nasty grunt** work. Forget it. Use one of the many service companies that do all or part of those dirty jobs. My favorite guys are the boys at Portland-based **West Coast Telecom** (call (503) 292-9357). I've had them print special floppy disk labels for me. **They'll do just about anything** and do it inexpensively. Other services include things like silk-screening slipcases, ¼-inch tape duplication, and producing an entire software package ready to sell. These folks are friends and have never asked me to give them a plug. So they get one.

Computer Solitaire Dept. or Sticking with Oregon Dept.: If you're bored stiff and want to play a variety of excellent solitaire games, then send $29.95 to Soft Cards, P.O. Box 25588, Portland, OR 97255; phone (503) 292-3922. The game program needs a color/graphics card. **It seems to use superb algorithms to help you analyze your play.** Sounds like a good Christmas gift for the solitaire nut. Insofar as packaging is concerned: Soft Cards, please give your neighbors at West Coast Telecom a call. PC



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■ JIM SEYMOUR

BETTER USER INTERFACES



Have you ever been frustrated with the devices you use to get in touch with your computer? Here are some ideas for improving the design of user interface hardware.

Last time we talked about some of the advantages of moving-bar-style menus, à la *1-2-3*, as opposed to the older pick-a-number routine, and about Personal Computer Support Group's extension of that user interface in its new spreadsheet, *Lucid 3D*.

I've long been interested in user interfaces and the quality of the metaphors behind them, because it is precisely at this point—where the rubber meets the road—that we have the best chance to make personal computers and software work better.

For several years I've been talking with people who've made important contributions to user interface design, asking what they like and hate, whose work they most admire, and where they think user interfaces are headed. More recently several of us here at *PC Magazine* have carried on a colloquy on this theme, poking and jabbing at interfaces we all know and use, and at ideas for improving them.

I think you'll find interesting some of the ideas from those sessions. Apart from the behind-the-scenes aspect, you'll enjoy some of their collective wisdom on interfaces.

The first step is to acknowledge that there are really three levels of interfaces to talk about. The first two are obvious, the last one less so. From the inside out, so to speak, first there's the software interface. Most people who get interested in better user interfaces focus their attention on software, so most of the ideas I've collected deal with better, more intelligent software design.

Next comes the PC's physical interface, such as keyboards, mice, speech recognition, and so on. And the last layer of interface, to steal columnist Frank Derfler's wonderful phrase, is "the wired environment"—that larger environment in which we and our computers exist.

TOTALLY WIRED "I want my computer to be sensitive to time of day, movement, environment, voice, and perhaps even more subtle factors such as physiology," Frank says.

"I want it to integrate these factors and do things for me *without my having to remember or routinely initiate them*. With the 80386 and a multitasking operating system, this isn't too much to ask. The sensors, from video to low-cost infrared to cheap pressure and heat devices, are there.

"For years people told me that voice recognition and voice synthesis were simply a matter of having enough fast and cheap memory," he says. "I think we should be about there.



"The real challenge is to stop thinking of the PC as something you sit *in front of* to run productivity tools. Unattended background-mode productivity activities like internal FAX machines are now popular. Real personal computers with multifunction operating systems ought to be doing personal tasks without receiving keyboard input.

"The trick is to think of what those tasks are and *then* to create the appropriate user interface."

Exactly. *Exactly*.

Moving in a bit, to the hardware-interface level, Spreadsheet Clinic proprietor Jared Taylor expects the hardware to be a lot smarter than it has been: "I don't want to have to deal with configuration or installation details. I want programs that sniff around in my hardware and figure out what's there. PS/2 should make this easier, but I want it *now*.

"If I put in a different graphics board, next time I run the program, I want it to say 'What-ho, a new graphics board!' and go right to work with it."

One of my hardware-interface bêtes noires is poor keyboard design and, on IBM's keyboards, keys that drift around from one version of the keyboard to the next. Editor Bill Machrone is enraged by this diddling with our motor-skills development, too: he wants IBM "to put the damn Ctrl key back where it belongs."

If you've seen the current IBM keyboard, you know what he means: from a convenient, logical, and widely accepted

Illustration: John Brealey

■ JIM SEYMOUR

layout, IBM has floated the Ctrl key out from its comfortable position between the Shift and Tab keys and moved it down where Alt used to be, beneath the Left Shift key—then added yet another Ctrl key off to the right, beneath the Enter and Right Shift keys. Maybe they could put another on the side of the keyboard. And another on the underside of the keyboard. And another

MOUSE CLUB Both Machrone and columnist John Dvorak, as well as many others, want ballistically controlled mice—that is, mice that move the cursor on-screen much faster when you move the mouse faster. For fine control, you move the mouse slowly and the cursor creeps along a pixel at a time. But swoop the mouse abruptly to the right just a couple of inches, and the cursor roars across the screen.

■ "Real personal computers with multifunction operating systems ought to be doing personal tasks without receiving keyboard input."

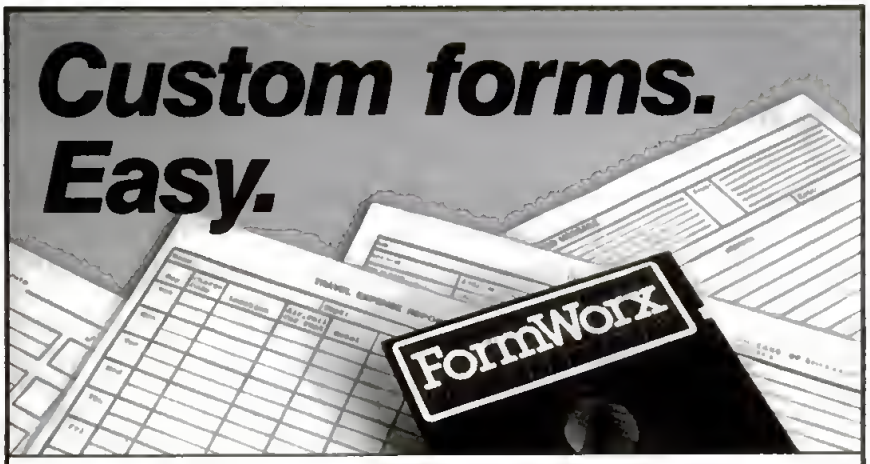
That kind of sensitivity to human habits (and in this case, human sloppiness: we never have enough room on our desks for mice) is interface design for the real world, not for engineers' convenience.

Executive editor Paul Somerson hates mice, not least because he thinks better, smarter cursor-key movement can outperform electronic rodents. Paul (and many of us) uses QUICKEYS.COM and SPEEDUP.COM utilities, respectively, on PCs and ATs, to accelerate cursor movement. The net effect is to get almost mouselike speed and control without removing your hands from the keyboard. (Check the PC Magazine Interactive Reader Service for both programs.)

Paul's preference for keyboard alternatives to external pointing devices points up a critical issue in good hardware-interface design: letting the user have a *choice*.

Rather than getting caught up in near-theological positions—"mice are *better* for you, damn it!"—smart computer and software vendors give us choices that help us feel at home with their new products far sooner than if we have to adopt a new religion just to write Mom a letter.

Next time: software interfaces.



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CIRCLE 174 ON READER SERVICE CARD

Dialog Business Connection: How to Go From $500 to $15.5 Million

In 1976, with three partners and $500, Ann Winblad founded a small software company. In 1983, they sold their company to UCCEL for $15.5 million. Her career has been extensively reported in FORTUNE, MONEY, COSMOPOLITAN and SCIENCE DIGEST. Now, as a San Francisco-based consultant, entrepreneur and long-time Dialog customer, she discusses her use of the new Dialog Business Connection$_{sm}$.



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CIRCLE 361 ON READER SERVICE CARD

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For those who may have missed it!

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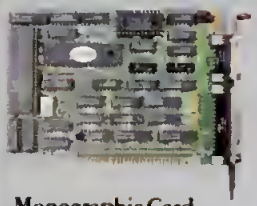
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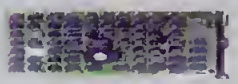


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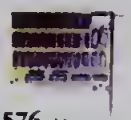
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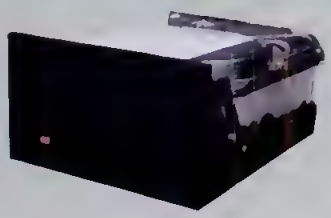
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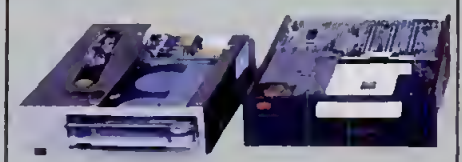
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■ STEPHEN MANES

THE UPGRADE ROAD: CURVES AHEAD!



The imminent arrival of OS/2 brings new pitfalls and mysteries to the black art of turning your sputtering old clunker into a souped-up speed machine.

A rumor abroad in the land has it that computer columnists spend much of their time fighting off hordes of overnight delivery persons bearing endless streams of high-performance hardware. Not here, folks: Those on the "funny stuff" B-list get only uproarious three-handled coffee mugs, boffo mouse-joke posters, and unintentionally hysterical software and press releases.

What you see on my computer stand is the same box that's been there since the distant days of 1982: Bambi ("IBM A B" spelled backwards; back then, naming your machine was considered almost hip), my early-model PC-1, complete with cassette port, IBM monochrome monitor, and the original keyboard that raised howls of protest until people discovered what really awful keyboards felt like.

There's still some IBM iron in the box—floppy drives and controller, 64K motherboard, puny power supply. The rest is Add-On City. So if you suspect I'm a believer in the power of upgrades, you're right. But upgrading from now on is going to take far more care than it once did.

It used to be easy. My upgrades began with an AST MegaPlus card that took Bambi way up to the heady maximum of 544K RAM. It also added the second parallel port I needed to install a brand-new daisy wheel printer alongside my plug-ugly dot matrix, plus the serial port for my state-of-the-art 1,200-bps modem.

The next serious upgrade began with the new ROM BIOS chip that could see 640K RAM and let DOS boot from my brand-new Kamerman outboard hard disk, which has outlasted its manufacturer's solvency. Last I looked, Kamerman was in Chapter 11; the drive still works.

Later on, AST's RAMpage! card bumped the MegaPlus from its slot. Some of the RAMpage!'s 2 megabytes of memory filled out the 640K limit, some of it turned into EMS RAMdisks, and the rest used PCSG's Lightning to cache the once-speedy but now woefully sluggish hard disk. AST's RAMpak daughterboard took care of serial and parallel ports.

A NEED FOR SPEED? Did I need the 286 microprocessor all my speed-demon friends were hailing while they crashed eight or ten of their high-performance hard disks? I did not. Or so I thought until I got involved in a major programming project and watched my computer go deaf to the world for 15 endless minutes at a time. A turbo-card upgrade came to the rescue. PCSG's Breakthru 286-8 in combination with my RAMdisks turned my machine into an AT-velocity speedster.



It also usurped the slot that held my CGA card, so I was stuck swapping cards or cords when I needed color. Surprisingly, a decent card with EGA, mono, and printer connectors doesn't seem to exist. A monochrome devotee, I moved to the Hercules Graphics Plus card and resigned myself to occasional board-swapping.

Newer and bigger software mysteriously transmogrified my hard disk's incredibly huge 10-megabyte capacity to an incredibly meager 10 megabytes, and I got tired of playing musical files. I retired it in favor of the elegant and speedy HardCard 40, which emits no noticeable noise, vibration, or radio interference (all plentiful with the old drive) and puts out less heat than the old controller alone. It's a honey. PCSG's 12-MHz Breakthru 12 turbo card with its improved software brought my system to its current souped-up state.

So will Bambi get any more improvements? Probably, but they're going to have to be chosen with exquisite care. The reason? In four ASCII characters: OS/2.

There's a ton of confusion about OS/2, and I personally would not attempt to testify under oath about any aspect of it. But one thing seems clear: upgrading old PCs and XTs to run it won't exactly be easy.

OS/2, remember, won't run with 8088 or 8086 microprocessors. You absolutely need an 80286 or 80386 processor. But hey, just install a turbo card, right?

With care. None of the current models are likely to run OS/2. Microsoft's newly announced MACH 20 turbo card, much of

Illustration: John Bradley

■ STEPHEN MANES

which was designed by PCSG's wizards, sounds absolutely dazzling and promises to do the job with the help of a special-edition OS/2 from Guess Who. It's reminiscent of one of the most successful upgrades in early microcomputer history: Microsoft's Apple II CP/M card. Others will undoubtedly follow, but a large dose of *caveat emptor* is in order.

And that's just the first of the caveats. OS/2 basically ignores machine and device BIOSes. In essence, it *is* the BIOS, interacting directly with the hardware. Since every storage device needs its own personal driver, you may—and "may" is the operative word, since opinions on this differ wildly—find it tough to get your hard disk and OS/2 to collaborate unless you bought the official IBM drive or know how to write or find the requisite driver software.

That may be a problem even with AT-class machines—especially those with "generic" hard disks of suspect parentage or oddball models that employ clever BIOS tricks to do their magic. Even the major hard-disk players are just beginning to wake up to the problem of retrofitting their customers' software for OS/2. Name-brand suppliers will probably respond to customer demands and write device drivers for their long-discontinued models. "No-name" drives may be orphaned unless they're dead ringers for something else. Similar problems may emerge with not-quite-standard video cards, which may need drivers of their own.

There are also potential pitfalls for less-than-perfect AT clones. OS/2's hardware dependency makes it unlikely that all "compatibles" will run IBM's OS/2 off the shelf as painlessly as they run PC-DOS. If, as has been suggested, many machines may need their own special "tweaked" version, which clone would you rather own: one from a big-name player like Compaq or one from Quitsu Computing, whose "Bad ATtitude" nameplate has historically graced any of seven different models from six different sources in four different countries? Next question.

Unless OS/2 turns out to be no more useful than a living, breathing TopView (and by most accounts that's simply not the case), "IBM-compatible" in the future is likely to mean "runs OS/2." Upgraders—and clone buyers—had better check their purchases carefully with an eye to the new operating system, or the upgrade products they buy today may well be obsolescent the day after tomorrow.

That is, of course, if you define the inability to run OS/2 as obsolescence—which might not turn out to be the case. But I'd proceed as if it will. The day after tomorrow, as the song and past upgrades prove, is only a day away. PC

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Webster Thesaurus	39
Word Perfect Executive	103
Work Perfect Library	54
Word Perfect (Ver. 4.2)	185
Wordstar w/Tutor 3.31	162
Wordstar Pro Pack 4.0	209
Wordstar 2000 Plus 2.0	189

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Pagemaker	465
PFS: First Publisher	49
Ventura Publishing	459

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Mace Utilities	49
Microsoft Windows	55
Norton Commander	36
Norton Utilities 4.0	49
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PC Tools	19
Printworks	36
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Referee	36
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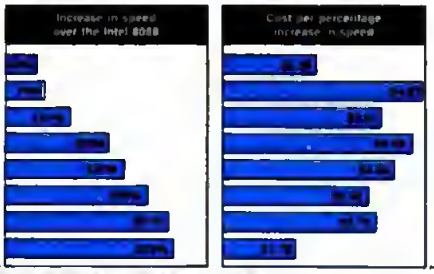
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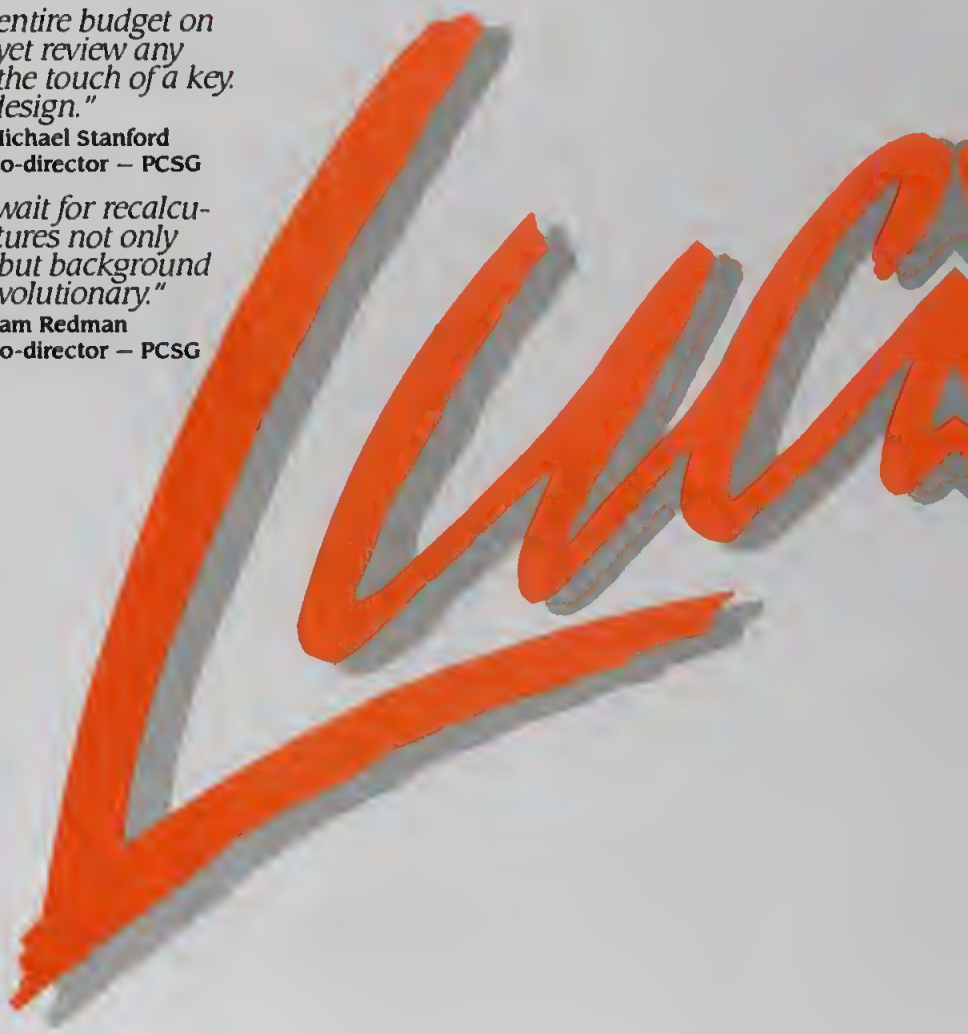
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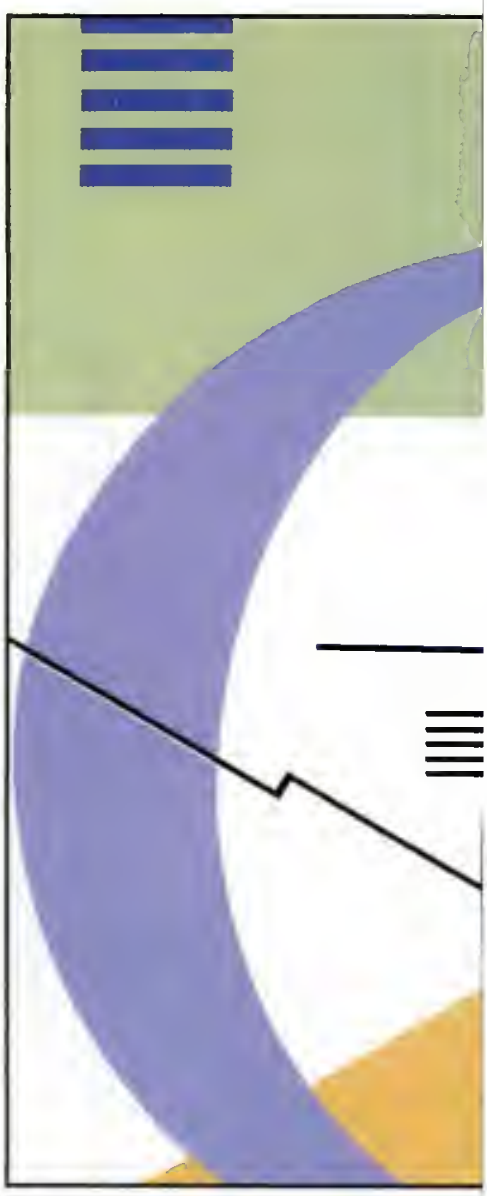
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THE 4th ANNUAL



Laser and 24-pin dot matrix printers share the limelight as 106 machines meet 12 reviewers in PC Magazine's fourth annual printer survey. The conclusion: you'll do more with and pay less for this year's crop.

This is the fourth edition of *PC Magazine*'s annual printer issue. Over the past 4 years PC Labs has spent more than 10,000 man-hours testing 120, 70, 97, and now 106 printers—393 in all that have been reviewed. A few others that failed the PC Labs gauntlet of speed, compatibility, and durability tests haven't been heard from since.

Since that first annual printer issue in November 1984, 3 months after the birth of the IBM PC AT, the market has seen substantial changes:

- Bang-for-the-buck has obviously improved. Dot matrix printers today run an average 31 percent faster than they did in 1984, based on PC Labs speed benchmark tests, and cost about 26 percent less. Even with the yen kicking sand in the dollar's face, prices on some dot matrix printers have fallen 10 to 25 percent in the past year. The era of the $500 24-pin dot matrix printer is fast approaching.
- Today's $2,500 business printer of choice is a laser printer that cranks out the whispery equivalent of 200 to 300 characters per second. Yesterday it was a clackety 55-cps NEC 7730/8850, NEC Spinwriter, or a Diablo 630 that didn't have a clue to the meaning of graphics.

ALL-PRINTER REVIEW

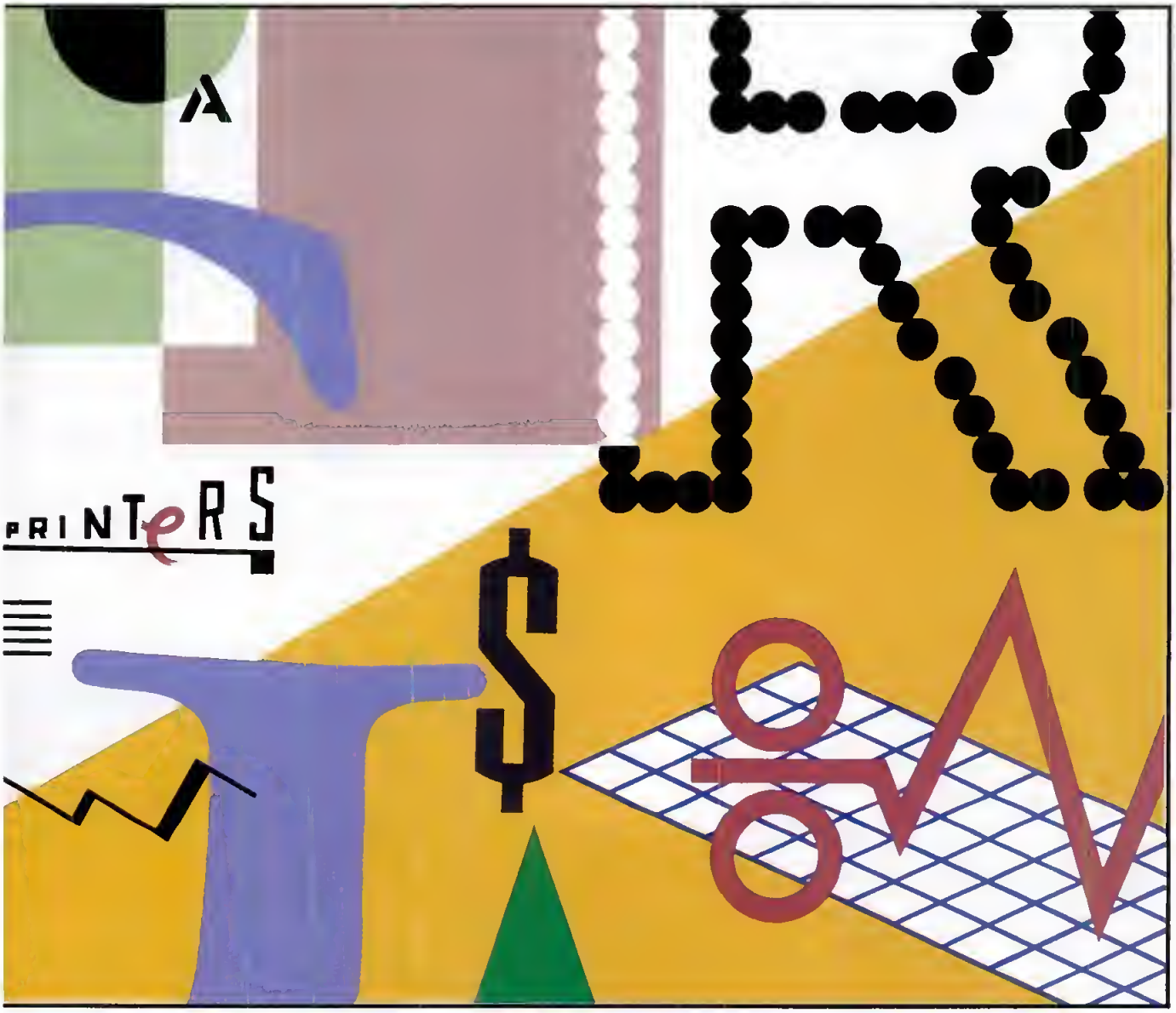


Illustration: Javier Romero

■ Automatic sheet feeding used to cost $1,000 extra on daisy wheel printers and was unheard of on dot matrix printers. Now it's built in on laser printers and costs only a few hundred dollars on many dot matrix and lower-end daisy wheel printers.

Of course, the more things change, the more they stay the same. The industry has yet to devise anything as simple and idiot-proof as the office Selectric for envelopes and that small run of file-folder labels. When you come right down to it, which would do more for your productivity in 1988: OS/2 running on a 20-MHz Compaq Deskpro 386 or a printer that conveniently handles Federal Express air bills?

Tractor-feed paper continues to snag printer cables and evade pin-feed mechanisms. And cryptic control panels assume users walk around chanting their mantras: "Hold select and form-feed as you power up; then quickly press line-feed twice and you'll go into compressed mode." And so on, and so on, and so on.

Perhaps the best way to summarize the printer part of the PC industry is to realize that although printers have made wondrous strides, they still have a long way to go before users reach nirvana. In other words, printers are just like everything else.

At the risk of recounting the obvious, here are your choices in printers:

Dot matrix printers Despite the endless fascination with laser printers, the dot matrix is the most common printer because it's relatively cheap and effective. By most estimates, dot matrix printers account for about two-thirds of the printers being sold today. The vast majority are impact dot matrix printers with 9 pins. Coming on fast are the 24-pin printers with side-by-side columns of 12 pins; the two columns with staggered vertical offsets help speed in draft mode, quality in near-letter-quality.

Print quality gets better with each new printer, and the business community has become more accustomed to the generally pleasing dot matrix output. But no matter what you read or hear, it's still *near*-letter-quality.

Laser (page) printers To trivialize a bit, laser printers are essentially photocopiers with a data cable in back. The light beam from an honest-to-goodness laser, powerful enough to cause eye damage if you were so dumb as to look inside (safety interlocks prevent you) but not quite powerful enough to bring down geosynchronous satellites, shines on an electrically charged photoconductor drum (the thing inside the laser printer that looks like a mirror wrapped around a cylinder). The light alters the charge. Powdered black toner with an opposite electrical charge adheres to the drum and is transferred to paper, permanently bonded by heat.

> Although printers have made wondrous strides, they still have a long way to go before users reach nirvana. In other words, printers are just like everything else.

Variants use light-emitting diodes and liquid crystal shutters. While manufacturers will argue their relative merits—as well as the merits of white-print and black-print page printers—to the user, the result is more alike than different: ultraquiet operation, 5- to 8-page-per-minute output, and 300-dot-per-inch resolution.

Laser and laserlike printers fall into five general categories:

■ LaserJet wannabes, the two dozen units that claim 6 to 8 ppm, HP compatibility, $2,000 to $3,000 list prices, and an intense desire to share in Hewlett-Packard's success. As PC Labs HP graphics compatibility tests made abundantly clear, some should be thought of as text-only devices.

■ Amazing-output devices, such as the Apple LaserWriter Plus, that speak the PostScript page description language and have more built-in smarts and more typographic ability than the HP clan—at higher prices. Some, like the NEC Silentwriter LC-890, have both emulations. These are the weapons of choice for the desktop publishing crowd.

■ Long-life $3,000-to-$5,000 printers offering heavier-duty cycles (such as the Quadram Quadlaser I and the Genicom 5010) and fast, long-life printers (exemplified by Kyocera's $8,395, 15.6-ppm F-3010). They're destined for small work groups linked by a smart printer-sharing box or on a network (but never, never put in a network just to share printers).

■ A handful of brain-dead units, so called because the controller card is the PC, not the printer. They're fine for dedicated single systems because graphics output is dramatically faster, but printer sharing is nearly impossible. Examples are the Cordata LP300 series, the Tall Tree JLaser cards, and the evolving Advanced Vision Research PageMaster system.

■ The 600-dpi-and-up plain-paper typesetters that cost somewhere between laser printers and film typesetters, such as the Varityper VT-600. Check Charles Petzold's kindly but scathing review to see why this category isn't quite there yet.

Since Hewlett-Packard revolutionized the printer business in 1984 with the $3,495 LaserJet, prices for lasers have dropped and keep dropping to the point where you can find a highly competent machine like the Okidata Laserline 6 for a street price of $1,400 and the LaserJet Series II for $1,750.

Daisy wheel printers A hammer whacks a plastic or metal petal with 88 to 96 spokes and transfers the character through a ribbon to the paper. NEC's once-dominant Spinwriters used a 64-spoke thimble wheel looking like, well, a large sewing thimble or a variation on the IBM Selectric ball.

Look in the dictionary under *dinosaur* and you're likely to see a picture of a Qume Sprint 11 or Diablo 630 ECS. The slowest laser printer produces a whisper-quiet 4 ppm; the fastest daisy wheel manages a shade over 2.5 ppm. For a rough comparison between ppm and cps, multiply or divide the speed test results by 30.

Only in the $500 to $1,000 range is there much of a market left for daisy wheels, and the most aggressive player is Brother, which says it is now shipping more units (although not necessarily doing greater dollar volume) than any of the big three of the first half of the decade: NEC, Diablo, and Qume.

Ink jet printers They're technically dot matrix printers, too, although everybody uses that term to speak of *impact* dot matrix printers that go *zzzzzzzt zzzzzzzzzt*.

TESTING THE PRINTERS

PC Labs has refined its printer benchmark tests once again for our fourth annual roundup of new printers.

PC Magazine invited 12 reviewers, most of them veterans of past printer projects, to the PC Labs for another go at testing the new printers—106 of them—that hit the market in the last year. Sounds like a huge undertaking, right? It always is.

The printer features table is a distillation of approximately 4,000 hours of testing, but much work was done before the reviewers—and the printers—arrived in the PC Labs. Anticipating *PC Magazine*'s largest full-scale evaluation project of the year, the PC Labs project leaders revised their tried-and-true printer benchmark tests, making them more comprehensive than ever before. Not only do the new tests measure the speed of wide-carriage printers and test the capabilities of PostScript printers more accurately, but they are also tougher on graphics and emulation pretenders.

As our 23-page table of printer features suggests, *PC Magazine* doesn't just report the manufacturers' claimed specifications. Instead, each category included in our table corresponds to a test developed in PC Labs for the express purpose of testing these claims and verifying their accuracy—or lack of it. The results of our reviewers' findings are then presented in tabular format so that you'll be able to see at a glance how machines of different types and different prices stack up against each other.

We think you'll agree that the new format of this year's printer features table, designed to be concise and easy to read, culls the most important statistics from the reviews, objectively bringing you the facts and figures our reviewers considered when they rated these 106 new machines.

The revised benchmark tests, which are available through the PC Magazine Interactive Reader Service electronic bulletin board, check the printers' claimed graphics and resolution compatibilities, generate text and graphics samples, and measure the printers' speeds. A sound level measurement is also included for dot matrix and daisy wheel printers.



With stacks of printers waiting in the wings, veteran reviewers and PC Labs project leaders put this year's crop of 106 printers to the test in PC Labs.

This year the test developers replaced the graphics test that used the *PC Magazine* logo with one that uses a pattern and line-resolution sample, a change that should add to your ability to see the printers' graphics and resolution capabilities in greater detail.

We've also lengthened the text sample shown in the features table. So that you can get a closer look at the output produced by each machine, our test now requires each printer to generate a five-line quality sample as well as a four-line sample of fonts and features. The astute quotation comes from a letter written in 1789 by Benjamin Franklin, a venerable printer himself.

Our revised speed tests—which were performed on all printers, including both narrow- and wide-carriage machines—were designed to simulate real-life print jobs more closely. Unlike some manufacturers that base their printers' speed ratings on tests that do not include page breaks or that do not measure print speeds with paper loaded into the machines, PC Labs tested the speed of dot matrix and daisy wheel printers by having them print a two-page single-spaced business letter containing 2,888 characters. Laser printers printed this letter ten times. On the whole, printer speeds now tend to be slightly higher than those of last year and more on a par with the manufacturers' claims.

After consulting with Adobe Systems, the developer of the PostScript page description language, PC Labs developed its first PostScript-compatibility test for laser printers. Aspiring desktop publishers will want to pay close attention to these results.

As usual, evaluations and descriptions of each printer follow in review articles. Here's where we put all the specs in context and where, we admit, we present some of our more subjective reactions to the printers. Each review is accompanied by a Fact File that lists manufacturer and pricing information and summarizes the printer's most important features, as well as by a photograph of the printer being reviewed.—**Donald P. Willmott**

Donald P. Willmott is an assistant editor of PC Magazine.

Photograph: Thom O'Connor

Their numbers are as small as these non-impact machines are quiet. They spray tiny drops of ink in a matrix pattern, and color models are available, such as HP's amazing PaintJet (see Mitt Jones's review of this 330-color marvel). Ink jet units work with plain paper, but most of them really need more costly clay-coated paper for best output. Clogging problems are markedly fewer than they were a few years ago.

Thermal transfer printers They're yet another dot matrix variety, typically used for color charts and graphs. A waxy ink from a ribbon or a transfer sheet is melted onto the paper.

Categories we aren't reviewing:

Line printers They print entire lines all at once, either with fully formed characters or with dot matrixes—unlike the serial matrix and serial fully formed printers that do a character at a time. They're expensive and more for mainframes and minis than for PCs.

Typewriter/printers There's a yearning among small-business and PC-at-home users for an electronic typewriter that's also a printer. They're good for limited-duty printing only. Street prices are in the $250-to-$500 range, plus $75 to $150 to add interfaces to machines that don't have them built in. Players include Brother, Canon, Olivetti, Olympia, Panasonic, and Royal Smith-Corona. This category may be covered in a future issue of *PC Magazine*.

Plotters Laser printers, especially those that speak HPGL (Hewlett-Packard Graphics Language, the lingua franca of the CAD set), and color dot-matrix printers can do many of the same things as plotters, but plotters don't stand a chance of imitating a text printer. They're reviewed apart from *PC Magazine*'s annual printer surveys, most recently in Volume 6 Number 11 (see "Big Draws: The New Large-Format Plotters").

Instant tutorial on plotters: Hewlett-Packard owns the market; IBM agrees (it relabels HP plotters); the other players are Houston Instrument, Bruning, CalComp, Ioline, and Roland; plotters are a ball to see in action; nobody buys two-pen plotters anymore (now it's six or eight); and if you want to produce plots the size of your desk, have at least $5,000 to $10,000 at the ready.

Printer categories we'd all love to see—and will, eventually—are color laser printers (prototypes may be shown in back rooms at the Fall Comdex) and affordable B-sized (11- by 17-inch) laser printers to be used for CAD, spreadsheets, and desktop publishing.

Mechanically, a printer is pretty much immune to failure. If it works correctly straight out of the box, it should run without mishap for years, requiring only changes of ribbons and other consumables.

ROOM FOR IMPROVEMENT Mechanically, a printer is pretty much immune to failure. If it works correctly straight out of the box, it should run without mishap for years, requiring only changes of ribbons and other consumables.

Whether you'll love those intervening years is another matter. For all their mechanical perfection, printers still have quirks that can drive you up the wall. What do they do wrong now? What could they do better? Here's a list, culled from a round-robin discussion among *PC Magazine* editors and contributors Frank Derfler, Jr., John Dvorak, Nora Georgas, Cheryl Goldberg, Stephen Manes, Jim Seymour, and Gus Venditto:

■ Abysmal front control panels I. If you have one of the ubiquitous power-switch-and-three-buttons (on-line, line-feed, form-feed) dot matrix machines, you have to remember arcane button sequences when you power up to set the machine into compressed or elite mode, and the instructions are seldom printed on the panel.

■ Abysmal control panels II. Hard-to-read LCDs and cryptic two-digit LEDs are the wrong place to save a few pennies. Just what does the blinking number 7 on the front panel mean? More machines should have 24-character LEDs you can read from at least 5 feet away that say things like "12 CPI NLQ, PERF SKIP ON."

■ Abysmal control panels III. Every printer above entry level should have these front-panel buttons: data-stream lockout that makes your printer ignore control codes sent from the PC, automatic perforation skip and/or half-inch left margin, and buffer-flush. The first is for times when you don't want to look up and type in a different 15-character *1-2-3* setup string for just this one print job; the second for printouts of unformatted text; the third when you realized you've screwed up the printout and want to try again. Hitting the power switch or pulling the paper tray on a laser printer guarantees a paper jam.

■ Too-small buffers. With memory so cheap, why not put a really useful buffer into printers—at least 64K, preferably 128K? Tiny 2K, 4K, and 8K buffers are a joke.

■ Inadequate paper handling. Why is a pin-feed or tractor-feed still optional on dot matrix printers? Do manufacturers hope paper wills itself to feed through straight? Power and data connections sometimes appear designed so that the cable hardware grabs and shreds tractor-feed paper.

■ Missing bottom-feed. The best way to avoid paper jams on dot matrix and daisy wheel printers is to feed paper through bottom slots. Too few printers have bottom slots.

■ Hidden power and DIP switches. The only place for the power switch is in front. DIP switches aren't accessed as frequently, but too often they're secreted in places where the sun doesn't shine, such as under the platen.

■ Poor sound insulation. Too bad dot matrix printers and the few remaining daisy wheels don't have stealth options that include slightly bulkier cases with massive amounts of sound-deadening material.

■ Polyglot printer-driver standards. Word processors now must devote one or more disks to emulate all the oddball printers out there, often because a printer says it can emulate an Epson LQ-1500 or IBM Proprinter, but it's really happier with the custom Yamagatzi Dotwriter driver. Compare this situation with that of the simpler world of modems: everybody emulates Hayes.

■ Bad VMI indexing. Know the white bands you get on a dot matrix graphics

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printout from a non-IBM/Epson printer? They're from companies that use a nonstandard vertical-motion-index spacing and then do a poor job of mathematically converting to Epson/IBM movement.

■ Expensive, idiosyncratic, hard-to-change ribbons. Aren't there enough ribbon designs to go around now? Why do manufacturers create new ones every month? Is it too much to ask Okidata to include a 5-cent disposable plastic glove with its $25 ribbon for an Oki 2410?

■ Top-of-form detector. Would that printers could use an optical or a mechanical sensor to determine the perforation at the top of a form and advance the paper accordingly.

■ Built-in printer-sharing devices. It's no secret that many lasers get shared among several users (see "Sharing Your Laser's Power," *PC Magazine*, Volume 6 Number 8). Compared with the $500-to-$1,000 cost of buying an external smart sharing device, it's rather trivial to build one in. As sharing devices become more common, software needs to be tweaked to keep from hanging the system if the sharing device is temporarily full.

■ Mindless font emulations. Genicom's first stab at emulating the HP Times Roman/Helvetica font cartridges on its excellent 5010 laser was the gap-toothed HP B cartridge, followed by the slightly better F cartridge, when it should have gone straight to the wonderful Z cartridge. Of course, there's almost no interchangeability between different companies' font cartridges, so you have to take what the maker offers.

■ The envelope crisis. Most printers have no easy method for dealing efficiently with envelopes. Too many laser printers crinkle envelopes, inadvertently heat-seal the flap, and fail to offer a special envelope-feed tray. IBM's Proprinters are among the very few dot matrix units with envelope slots (you don't have to unload tractor paper to use them). The plastic card guides on daisy wheels are fiendishly designed to grab, fold, and ink-smudge the upper-left-hand corners of envelopes. No wonder so many laser-printed letters go out the door in hand-addressed envelopes.

Most printers have no easy method of dealing efficiently with envelopes. Too many laser printers crinkle envelopes, inadvertently heat-seal the flap, and fail to offer a special envelope-feed tray.

ALL IN ORDER The 98 reviews of 106 printers are organized into three main categories: 36 lasers, 65 dot matrixes (including ink jet, thermal transfer, and Brother's hybrid dot/daisy Twinriter 6), and 5 daisy wheels. Reviews are arranged in alphabetical order by company name within the sections, Alps before Epson before Toshiba. Features tables compare print quality, speeds, prices, available fonts and print enhancements, and compatibility with established printer standards.

Finally, a historical index summarizes 259 of the 393 printers that were tested over the past four years and are still available. At the request of readers, the index has been expanded to include the type of printer, highest tested speed (based on PC Labs benchmark tests, not inflated manufacturer claims), price then and now, whether the printer is still in production or whether it's been superseded by another model, and when it was reviewed. Even if a printer is out of production, it may be available used, or you may be offered the printer as a hand-me-down from a power user who finally convinced the budget-review committee that he deserves that LaserJet.—**Bill Howard**

Bill Howard is an executive editor of PC Magazine.

The PC Magazine Printer Guide

PC Magazine's Printer Guide provides data pertinent to your printer purchase decisions. Results come from PC Labs benchmark tests and hands-on evaluations.

PRINT QUALITY

To allow you to judge text print quality, five lines of best-quality text and four lines of different font samples are shown. The graphics samples—a gray scale and a series of rules—were created using Aldus Corp.'s *PageMaker* running under *Microsoft Windows*. The program was compatible with a wide range of popular printers, but not all. Therefore, we've noted whether printers with no samples shown are unable to print graphics or are incompatible with our tests.



SPEED

Rated speeds were obtained from the manufacturers. *Default* refers to tested speed in draft mode; *quality* refers to tested speed in near-letter-quality mode. For dot matrix and daisy wheel printers, speed was measured in characters per second and was tested using a 2,888-character, two-page business letter, run once. Laser speed was measured in pages per minute. For the laser speed test, the same typical, two-page single-spaced business letter containing 2,888 characters per page was used; it was printed ten times. In this case 1 page per minute equals approximately 48 characters per second.

TYPE PITCHES

To give you a point of reference, 10 characters per inch (cpi) is typical pica type, 12 cpi is typical elite, and 17 cpi is typical condensed mode. For laser printers, the unit of measurement is point size rather than pitch. One point equals approximately 1/72 inch. There are 12 points in a pica.

FEATURES

A list of each printer's printing and formatting features tells you how far beyond plain-vanilla printing it will go.

PRINTING FEATURES

Bold	Boldface
Comp	Compressed
DS	Double-strike
Ital	Italic
NLQ	Near-letter-quality (correspondence)
SmCap	Small capitals
S/S	Subscript/superscript
UL	Underline

FORMATTING FEATURES

Cen	Centered
DblHi	Double high
HTab	Horizontal tabs
Just	Justified
PS	Proportional spacing
VFL	Variable form length
VLH	Variable line heights
VTab	Vertical tabs

SOUND LEVEL

Sound level doubles for each 10-decibel increase under real-life conditions. The average printer pounds away at 72 decibels, indicated by a rule on the graph. Compare that with the 20 decibels of rustling leaves, the 50 decibels of the average office, or the 120 decibels of a rock concert. Although our equipment doesn't test accurately below 50 decibels, the manufacturers' ratings indicate that the laser printers are well below that level. The bar shows the measured decibel level.



COMPATIBILITY

The Printer Guide reports on each printer's character compatibility with IBM's low-order (ASCII code 0–127) and high-order (ASCII code 128–255) character set. Low-order characters represent the letters, numbers, and symbols found on the keyboard. The high-order IBM display characters include some line- and box-drawing characters that are useful for nongraphics drawing programs. If your printer properly emulates (is compatible with) the text or graphics of a printer that your applications program supports, you'll have no trouble printing your output. We've tested for each printer's emulation of many of the more-common printers. Following are the printer abbreviations used in the Printer Guide:

D630	Diablo 630
EpFX	Epson FX
EpFX80	Epson FX-80
EpFXseries	Epson FX Series
EpJX	Epson JX
EpLQ	Epson LQ
EpMX	Epson MX
HPLJ	Hewlett-Packard LaserJet
HPLJ+	Hewlett-Packard LaserJet Plus
HPQJ	Hewlett-Packard QuietJet
HPThJ	Hewlett-Packard ThinkJet
IBMCol	IBM 5182 Color Printer
IBMGr	IBM 5152 Graphics Printer
IBMPro	IBM Proprinter
NSp	NEC Spinwriter
Post	PostScript
QS11	Qume Sprint 11
QS11+	Qume Sprint 11 Plus
Tosh	Toshiba P351

PC —Indicates Editor's Choice

Laser

TYPE / MAX PAPER WIDTH (in.) / LIST PRICE	SPEED (ppm) / TYPE SIZE (points)	PRINTING FEATURES / FORMATTING FEATURES	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

BlaserStar

Laser
8.5
$2,395

8 rated
5.5 default
8.5
10
12

Bold	
Comp	
	S/S
Ital	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

IBM low, IBM high
EpMX, HPLJ +
D630, EpFX80, HPLJ +

HP LaserJet Plus amulation



Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes. -Ben
10 pitch Bold Underline Compresse
12 pitch Bold Underline Compressed *Ita*
Lineprinter Bold Underline Compressed *Italic*

Canon LBP-8II

Laser
8.5
$2,750

8 rated
7.4 default
8.5
8.2
12

Bold	
	S/S
Ital	UL
	PS
	VFL
DblHi	
HTab	VLH
	VTab

IBM low, IBM high
None
D630

Graphics ara not com-palibla with our tests

Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes. -Ben
10 pitch Bold Underline Compresse
12 pitch Bold Underline Compresse
Lineprinter Bold Underline Compreeeed *Italic*

CIE LIPS 10 Plus

Lasar
8.5
$2,995

10 rated
8.9 default
8.5
8
8.5
10
12

Bold	
	UL
	PS
	VFL
HTab	VLH
	VTab

IBM low
EpFX80,HPLJ +
D630, EpFX80, HPLJ +

HP LaserJet Plus amulation



Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes. -
10 pitch Bold Underline Compressec
12 pitch Bold Underline Compressed *Ital*
Lineprinter Bold Underline Compressed *Italic*

C. Itoh Jet-Setter

Laser
8.5
$1,795

5 rated
4.9 default
8.5
8.5
12

Bold	
Comp	
	S/S
	UL
	VFL
HTab	VLH
	VTab

IBM low
D630, EpFX80, HPLJ +
D630, EpFX80, HPLJ +

HP LasarJet Plus emulation



Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes. -
10 pitch Bold Underline Compresse
12 pitch Bold Underline Compresse
Lineprinter Bold Underline Compressed Italic
Courier Bold Bold Underline Con

Cordata LP300X

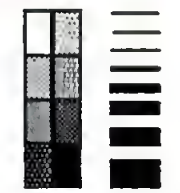
Laser
8.5
$2,695

8 rated
4.1 default
6 14
7 18
8 20
9 24
10 36
12

Bold	
Comp	
	S/S
Ital	UL
	PS
	VFL
HTab	VLH
Just	

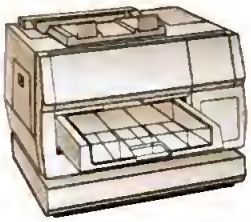
IBM low, IBM high
EpMX
EpMX

Epson MX amulation



Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes. -Ben
10 pitch Bold Underline Compress
12 pitch Bold Underline Compressed *Itali*
Dutch Bold Underline Compressed *Italic* Compr

Inside thes revolution



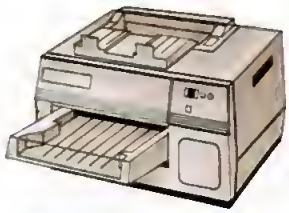
NBI, Inc. Model 908



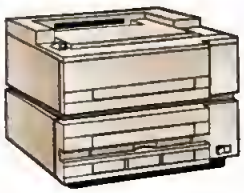
QMS-PS® 800
QMS-PS® 800+
QMS-PS® 800 II



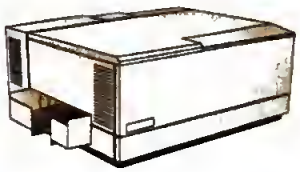
Linotype Company Linotronic™ 100
Linotype Company Linotronic™ 300



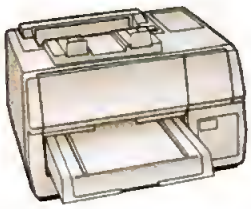
Digital Equipment Corp.
ScriptPrinter™



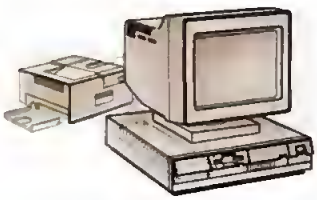
Qume Corporation ScripTEN™



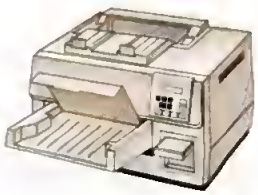
Diconix Dijit® I/PS



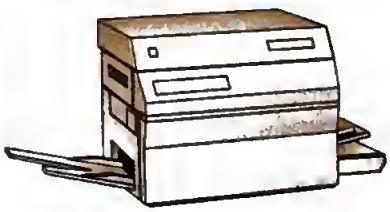
AST Turbo Laser®/PS



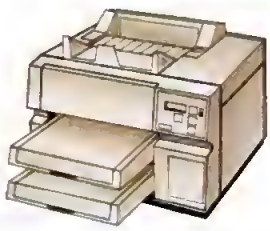
IBM 4216-020 Personal Pageprinter™



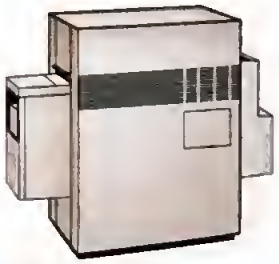
Texas Instruments OmniLaser™ 2108



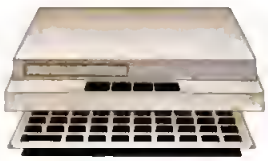
Varityper VT-600



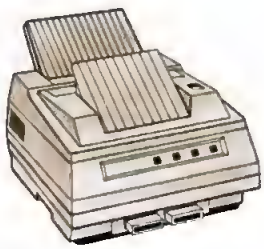
Wang LCS15™



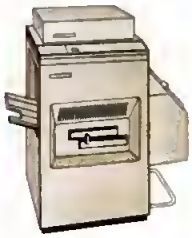
Agfa-Gevaert P400PS™



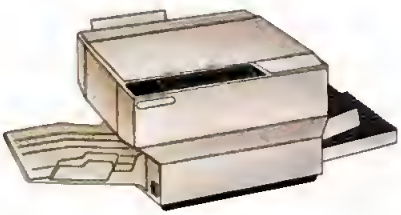
The Laser Connection PS Jet/PS Jet+™



NEC Information Systems
SilentWriter™ LC-890

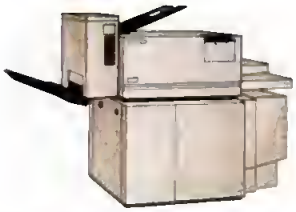


QMS-PS® 2400

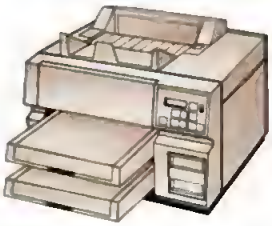


Apollo Computer Inc.
Domain/Laser 26™

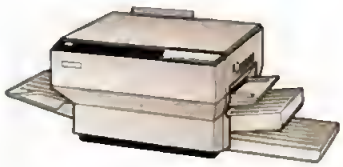
e printers a is going on.



Digital Equipment Corp. PrintServer 40™



Texas Instruments OmniLaser™ 2115



Dataproducts Corp. LZR™ 2665

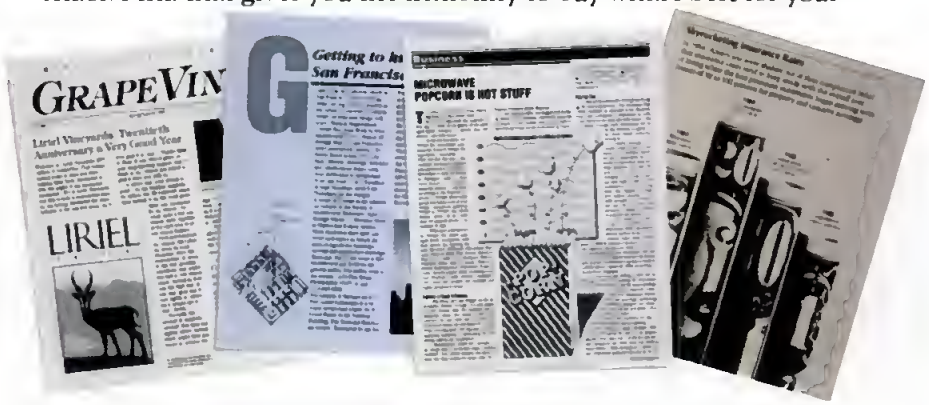


Apple Computer Inc. LaserWriter®
Apple Computer Inc. LaserWriter® Plus

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company's needs. Since POSTSCRIPT is device independent, you can design a document, then professionally print it later at a higher resolution.

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POSTSCRIPT from Adobe. The Magic Behind Desktop Publishing.

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CIRCLE 725 ON READER SERVICE CARD

Laser

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (ppm) TYPE SIZE (points)	PRINTING FEATURES FORMATTING FEATURES	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Dataproducts LZR 1230

Laser
8.5
$3,495

12 rated
10.9 default
8.5
10
12

Bold	
	UL
Cen	PS
DblHi	VFL
HTab	
Just	VTab

IBM low, IBM high
EpFX80, HPLJ+
D630, EpFX80, HPLJ+

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. -
10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed *Ita*
Lineprinter Bold Underline Compressed *Italic*
Times Roman Bold Underline Compressed Italic C

Data Technology CrystalPrint VIII

Liquid Crystal Shutter
6.5
$2,495

6 rated
6 default
8.4
12

Bold	
	UL
	PS
	VFL
	VLH

IBM low
HPLJ+
HPLJ+

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. -
10 pitch Bold Underline Compressed
Lineprinter Bold Underline Compressed Italic

Destiny Laser Act I

Laser
8.5
$2,595

6 rated
5.8 default
8.5
12

Comp	
	S/S
	UL
	VFL
HTab	VLH
	VTab

IBM low
HPLJ+
HPLJ+

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. -
10 pitch Bold Underline Compressed
Lineprinter Bold Underline Compressed Italic

Epson GQ-3500

Laser
6.5
$2,199

6 rated
5.4 default
6
10
12

Bold	
	S/S
Ital	UL
	PS
DblHi	VFL
HTab	VLH
	VTab

IBM low, IBM high
EpLQ
EpLQ

Epson LQ emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. -
10 pitch Bold Underline Compre
12 pitch Bold Underline Compressed
Pica Bold Bold Underline Compr

Genicom Centronics PagePrinter 8

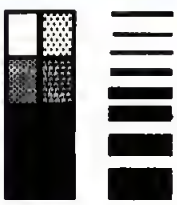
Laser
8.5
$2,495

8 rated
7.5 default
12

Bold	
Comp	
D5	S/S
Ital	UL
Cen	
DblHi	VFL
HTab	VLH
Just	VTab

IBM low, IBM high
EpMX80, HPLJ, IBMPro
D630, EpFX80, HPLJ, IBMGr, IBMPro

Epson MX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. -
10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed *I*
Lineprinter Bold Underline Compressed *Italic* C
Proportional Bold Underline Compr

OUR BIGGEST FEATURE IS OUR SMALL PRICE.

10 Mhz EGA $1175. COMPLETE.

SYSTEM

- 10 Mhz 80286
- 512K Memory expandable to 1 megabyte on the mother-board
- 6.67/10 Mhz Keyboard selectable
- Small footprint
- Multi speed 80287 socket (6/8/10 Mhz)
- OS/2 Ready and Waiting

DISPLAY

- EGA Standard with full 256K memory
- EGA Backward-compatible with CGA, Hercules and MDA
- High resolution tilt-swivel amber mono-chrome monitor



SERVICE

- Free lifetime technical support
- 30-day complete-satisfaction guarantee
- Full 12-month warranty
- All systems are tested under full configuration for 24 hours
- Complete documentation

MORE FEATURES

- High speed Award BIOS Rom-based setup program
- Battery backed real-time clock/calendar
- 1.2 M8 floppy disk drive
- 101 enhanced click-tactile keyboard
- Hardware reset button
- 8 expansion slots
- 180 Watt power supply, 110/220V switchable

Vector

VECTOR COMPUTER CORPORATION

7 VERNON STREET, NORWOOD, MA 02062 (617) 769-6714

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CIRCLE 340 ON READER SERVICE CARD

Laser

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (ppm) / TYPE SIZE (points)	PRINTING FEATURES / FORMATTING FEATURES	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Genicom 5010

Laser
8.S
$3,495

10 rated
8.S default

8
10
12

Bold	
Comp	
DS	S/S
	UL
	PS
HTab	VLH
	VTab

IBM low, IBM high
HPLJ+, IBMPro
D630, HPLJ+, IBMGr

IBM Proprinter emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
10 pitch **Bold** Underline Compressed
12 pitch **Bold** Underline Compressed Ita
Lineprinter **Bold** Underline Compressed Italic

PC Hewlett-Packard LaserJet Series II

Laser
8.S
$2,595

8 rated
7.S default

8.S
12

Bold	
Comp	
	UL
	PS
	VFL
HTab	VLH

IBM low, IBM high
HPLJ+
HPLJ+

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
10 pitch **Bold** Underline Compressed
12 pitch Bold Underline Compressed Italic Com
Lineprinter Bold Underline Compressed Italic

Kyocera F-1010

Laser
8.S
$3,695

10 rated
9.2 default

6 12
7 14.4
7.2
8
9
10

Bold	
Comp	
DS	S/S
Ital	UL
	PS
	VFL
	VLH
Just	

IBM low, IBM high
EpFX80, HPLJ+, IBMGr
D630, EpFX80, HPLJ+, IBMGr, NSp, QS11

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
10 pitch **Bold** Underline Compressed
12 pitch **Bold** Underline Compressed *Ita*
Lineprinter **Bold** Underline Compressed *Ital*
Times Roman Proportional **Bold** Underline

Kyocera F-2010

Laser
8.S
$4,695

10 rated
8.8 default

8 12
7 14.4
7.2
8
9
10

Bold	
Comp	
DS	S/S
Ital	UL
	PS
	VFL
	VLH
Just	

IBM low, IBM high
EpFX80, HPLJ+, IBMGr
D630, EpFX80, HPLJ+, IBMGr, NSp, QS11

HP LaserJet Plus emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
10 pitch **Bold** Underline Compressed
12 pitch **Bold** Underline Compressed *Ita*
Lineprinter **Bold** Underline Compressed *Ita*
Times Roman Proportional **Bold** Underline

Kyocera F-3010

Laser
8.S
$8,395

18 rated
1S.8 default

8 12
7 14.4
7.2
8
9
10

Bold	
Comp	
DS	S/S
Ital	UL
	PS
	VFL
	VLH
Just	

IBM low, IBM high
EpFX80, HPLJ+, IBMGr
D630, EpFX80, HPLJ+, IBMGr, NSp, QS11

HP LaserJet Plus emulation



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10 pitch **Bold** Underline Compressed
12 pitch **Bold** Underline Compressed *Ita*
Lineprinter **Bold** Underline Compressed *Ital*
Times Roman Proportional **Bold** Underline



Epson® Printer, 1987.

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PS/2™ TAPE BACKUP. RELIABLE. AFFORDABLE AND AVAILABLE.



FEATURES	MOUNTAIN TD4000
New QIC-40 Standard	YES[1]
LAN Support	YES—Novell,* 3Com,* PCnet,* TOKEN RING * and more
Concurrent LAN Backup	YES—backup while network is running
Dual Floppy Support	YES—runs with both floppy drives installed
IBM PS/2 & PC Compatible	YES—Models 25, 30, 50, 60 and 80; PC, XT, XT286 * and AT
High-Speed Rewind	YES—26 seconds
Automatic Track Alignment	YES—assures data interchange even on mis-aligned tracks
Fast Formatting	YES—single pass
Advanced Data Recovery	YES—compensates for faded or worn tapes
Auto Tape Erase	YES—automatic during formatting
Full Shock Mounting	YES
Menu-Driven Software	YES—RATED BEST
Reliability	YES—Level 3 Reed-Solomon ECC

[1]QIC-40 is the first cartridge data standard assuring file transfer compatibility between multiple manufacturers' drives.
*FileSafe has been tested and approved by Novell



Mountain delivers the first tape backup system for the new IBM® PS/2™ computers (Models 25, 30, 50, 60 and 80).

At the same time, our FileSafe™ Tape Series 4000 also provides IBM XT,™ AT™ and most compatible computer users with a choice of 40 megabytes in one internal and two zero-footprint external versions.

Which means Mountain has reliable and affordable tape backup to protect all your valuable data. Simply ask for FileSafe and relax.

THE CHOICE IS EASY.

Compared to the competition, FileSafe Series 4000 provides more advanced features, greater LAN support, and easier-to-use software. It's also faster, more rugged and requires less power.

And unlike some tape backup systems, it incorporates the new international cartridge interchange standard (QIC-40) that now makes reliable tape backup more affordable than ever.

Plus it comes with Mountain's unique 12-month limited warranty featuring "Ready Replacement" anytime within the first six months, and a 10-year record of responsive support.

LOOK TO MOUNTAIN.

Take a close look at our FileSafe Tape Series 4000. You'll quickly see why tens of thousands of professional, business and government systems users worldwide come to Mountain for the best values in tape backup. Call us today for more information and the name of your nearest Mountain dealer or distributor.

PC MAGAZINE EDITOR'S CHOICE

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Mountain.

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CIRCLE 107 ON READER SERVICE CARD

Laser

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (ppm) / TYPE SIZE (points)	PRINTING FEATURES / FORMATTING FEATURES	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

The Laser Connection Big Kiss II

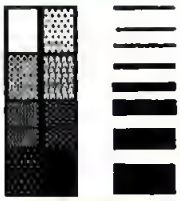
Laser
8.5
$4,495

8 rated
7.5 default

S
8
10
12

Bold		IBM low, IBM high
Comp		
DS	S/S	EpMX80
Ital	UL	
Cen	PS	D630, EpFX80, QS11
	VFL	
HTab	VLH	
Just	VTab	

Epson MX emulation



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed
Lineprinter Bold Underline Compr
Q-Roman Proportional Bold Underline Compresse

The Laser Connection PS Jet

Laser
8.5
Variable
$4,995

8 rated
8.3 default

Bold		IBM low
Comp	SmCap	
	S/S	D630, HPLJ, Post
Ital	UL	
Cen	PS	D830, HPLJ, Post
DblHI	VFL	
HTab		
Just	VTab	

PostScript



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Courier **Bold** Underlined *Italic*
Palatino Bold Underlined Italic Compressed
Helvetica **Bold** Underlined *Italic* Compresse

Mannesmann Tally 910

Laser
8.5
$3,695

10 rated
9 default

8
10
12

Bold		IBM low, IBM high
Comp		
		HPLJ, EpFX80, IBMPro
Ital	UL	
Cen	PS	D630, EpFX80, HPLJ, IBMPro, QS11+
	VFL	
HTab	VLH	
Just	VTab	

Epson FX emulation



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed I
Lineprinter Bold Underlioe Compressed *Italic*
Expanded Bold U

NEC Silentwriter LC-850

Laser
8.5
$2,295

8 rated
7.8 default

10
12

Bold		IBM low, IBM high
Comp		
DS	S/S	IBMPro
Ital	UL	
Cen	PS	IBMPro
	VFL	
HTab	VLH	
Just	VTab	

IBM Proprinter emulation



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Ita
Lineprinter Bold Underline Compressed Italic C

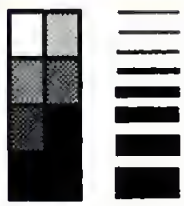
NEC Silentwriter LC-890

Laser
8.5
Variable
$4,795

8 rated
8 default

Bold		IBM low
Comp	SmCap	
	S/S	D630, Post
Ital	UL	
Cen	PS	D630, HPLJ, Post
DblHI	VFL	
HTab		
Just	VTab	

PostScript



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes.
Courier **Bold** Underlined *Italic*
Palatino Bold Underlined *Italic* Compressed
ZapfChancery Bold Underlined Italic Compressed

Laser

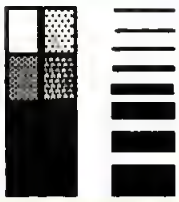
TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (ppm) / TYPE SIZE (points)	PRINTING FEATURES / FORMATTING FEATURES	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Oasys LaserPro Express

Laser | 8 rated, 7.4 default | Bold, Comp, DS, S/S, Ital, UL | IBM low, IBM high; D630, EpMX, HPLJ, IBMPro | Epson MX emulation

8.5 | 8.5, 9.5, 10, 12, 14.4 | PS, VFL, HTab, VLH, VTab | D630, EpFX80, HPLJ, IBMGr, IBMPro

$1,895



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Ital
Lineprinter Bold Underline Compressed Italic Compre
Vetica Bold Underline Compressed Ita

Oasys LaserPro Express Series II

Laser | 8 rated, 7.4 default | IBM low, IBM high; EpFX80, HPLJ+ | HP LaserJet Plus emulation

8.5 | 8.5, 9.5, 10, 12, 14.4 | Cen, PS, VFL, HTab, VLH, Just, VTab | D630, EpFX80, HPLJ+

$2,295



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Ital
Lineprinter Bold Underline Compressed Italic
Expanded Bold Underline Compr

Oasys LaserPro Silver Express

Laser | 8 rated, 7.4 default | Bold, Comp, OS, S/S, Ital, UL | IBM low, IBM high; D630, EpMX, HPLJ+ | Epson MX emulation

8.5 | 6, 8.5, 10, 12, 14.4 | PS, VFL, HTab, VLH, VTab | D630, EpFX80, HPLJ+, IBMGr, IBMPro, QS11

$2,795



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Ital
Lineprinter Bold Underline Compressed Italic Compre
Vetica Bold Underline Compressed Ita

PC Okidata Laserline 6

Laser | 8 rated, 8.8 default | Bold, S/S, UL | IBM low; HPLJ+ | HP LaserJet Plus emulation

8.5 | 8, 8.5, 10, 12, 14.4 | PS, VFL, VLH | HPLJ+

$1,995



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10 pitch Bold Underline Compre
Lineprinter Bold Underline Compressed Italic Compr
Times Roman Bold Underline Compressed Ita

Personal Computer Products LaserImage 2000

Laser | 8 rated, 7.5 default | Comp, UL | IBM low, IBM high; EpFX80, EpMX, HPLJ+ | HP LaserJet Plus emulation

8.5 | 8.6, 12 | Cen, PS, VFL, HTab, VLH, Just, VTab | None

$3,495



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Ita
Lineprinter Bold Underline Compressed Italic (

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Laser

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Personal Computer Products LaserImage 3000

Laser
8.5
$6,395

15 rated
7.3 default
8
9
10
12
14

Bold
Comp
Ital
Cen
HTab

S/S
UL
VFL
VLH
VTab

IBM low, IBM high
EpFX80, HPLJ+, IBMPro
D630, EpFX80, HPLJ+, IBMPro

HP LaserJet Plus emulation



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10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed Italic Con
Lineprinter Bold Underline Compressed Italic
Times Roman Bold Underline Compressed I

Printronix L1012

Laser
8.5
$3,495

12 rated
9.9 default
8.5
10
12

Bold
Cen
DblHi
HTab
Just

UL
PS
VFL
VTab

IBM low, IBM high
HPLJ+, EpFX80
D630, EpFX80, HPLJ+

HP LaserJet Plus amulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed I
Lineprinter Bold Underline Compressed Itali

Printware 720 IQ Laser Imager

Laser
8.5
$12,980

8 ratad
6.7 default
Variable

Bold
Comp
Ital
Cen
DblHi
HTab
Just

S/S
UL
PS
VFL
VLH

IBM low
None
None

Graphics are incompatibla with our tests

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10 pitch Bold Compressed Italic Cc
12 pitch Bold Compressed Italic Compressed
Lineprinter Bold Compressed Itali
Superscr

QMS PS-800 Plus

Laser
8.5
$5,495

8 rated
8.1 default
Variable

Bold
Comp
Ital
Cen
DblHi
HTab
Just

SmCap
S/S
UL
PS
VFL
VTab

IBM low
HPLJ+, Post
HPLJ+, Post

PostScript



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Courier Bold Underlined Italic
Palatino Bold Underlined Italic Compressed
ZapfChancery Bold Underlined Italic Compressed

QMS SmartWriter 80 Plus

Laser
8.5
$4,595

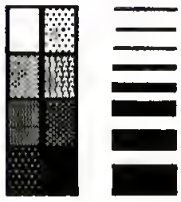
8 rated
7.5 default
6
8
10
16

Bold
Comp
DS
Ital
HTab
Just

S/S
UL
PS
VFL
VLH
VTab

IBM low, IBM high
D630, HPLJ+, IBMPro
D630, HPLJ, IBMPro, QS11

HP LaserJet Plus amulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
10 pitch Bold Underline Compressed
12 pitch Bold Underline Compressed *Ital*
Lineprinter Bold Underline Compressed *Italic* Compress
Q-Roman Medium Bold Underline

Strokes Of Genius.

If you haven't been to Europe or taken a world tour lately, you may not have heard of AMSTRAD. So, let us introduce ourselves.

AMSTRAD is a British company that makes the best selling computer in Europe.* We even outsell IBM. And worldwide, over 2,000,000 AMSTRAD computers have been sold — not to mention all the AMSTRAD printers and word processors in use.

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To find out more about putting brilliant performance in your hands, send in the reply form for the name of your nearest AMSTRAD Dealer. You'll see for yourself, you don't have to be an Einstein to be a genius. Just smart enough to buy AMSTRAD.

Please send me the name of my nearest AMSTRAD Dealer.

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*ADDRESS*_____

*CITY*_____ *STATE*____ *ZIP*_____

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*Source International Data Corp

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Laser

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (ppm) TYPE SIZE (points)	PRINTING FEATURES FORMATTING FEATURES	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Quadlaser I

TYPE	SPEED (ppm)	PRINTING FEATURES		CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES
Laser 8.5 $3,795	8 rated 7.5 default 10	Bold Comp DS Ital HTab	S/S UL PS VFL VLH VTab	IBM low, IBM high EpFX80, HPLJ EpFX80, HPLJ	Epson FX emulation	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - 10 pitch Bold Underline Compressed 12 pitch Bold Underline Compressed Itali Lineprinter Bold Underline Compressed Times Roman Bold Underline Compr

Qume LaserTENPlus

TYPE	SPEED (ppm)	PRINTING FEATURES		CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES
Laser 8.5 $3,395	10 rated 8.8 default 7 10	Bold Comp DS Ital HTab	S/S UL PS VFL VLH VTab	IBM low, IBM high EpFX80, IBMGr, IBMPro EpFX80, HPLJ+, IBMPro, IBMGr	Epson FX emulation	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - 10 pitch Bold Underline Compressed Lineprinter Bold Underline Compressed Italic C

Ricoh PC Laser 6000

TYPE	SPEED (ppm)	PRINTING FEATURES		CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES
Laser 8.5 $2,395	6 rated 6 default 8 10 12	Bold Cen HTab Just	UL PS VFL VLH VTab	IBM low HPLJ+ HPLJ+	HP LaserJet emulation	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - 10 pitch Bold Underline Compressed 12 pitch Bold Underline Compressed Ita Lineprinter Bold Underline Compressed Italic Times Roman Bold Underline Compressed

Texas Instruments OmniLaser 2108

TYPE	SPEED (ppm)	PRINTING FEATURES		CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES
Laser 8.5 $5,995	8 rated 7.4 default Variable	Bold Comp Ital Cen DblHi HTab Just	SmCap S/S UL PS VFL VTab	IBM low EpFX80, HPLJ, Post D630, EpFX80, HPLJ, Post, TI	PostScript	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. Courier Bold Underlined *Italic* Helvetica Bold Underlined *Italic* Compresse 12 pitch Bold Underline Compressed *Ita*

Texas Instruments OmniLaser 2115

TYPE	SPEED (ppm)	PRINTING FEATURES		CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES
Laser 8.5 $7,995	15 rated 9.5 default Variable	Bold Comp Ital Cen DblHi HTab Just	SmCap S/S UL PS VFL VTab	IBM low EpFX80, HPLJ+, Post D630, EpFX80, HPLJ+, Post, TI	HP LaserJet Plus	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - 10 pitch Bold Underline Compressed 12 pitch Bold Underline Compressed *Ita* Helvetica Bold Underlined *Italic* Compresse Lineprinter Bold Underline Compressed *Italic*



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Laser

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (ppm) TYPE SIZE (points)	PRINTING FEATURES FORMATTING FEATURES	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Varityper VT-600

Laser 8.5 **$18,750**	10 rated 5.6 default Variable	Bold Comp Ital Cen DblHi HTab Just	SmCap S/S UL PS VFL VTab	IBM low Post Post	PostScript



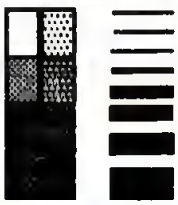
Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes.
Courier **Bold** Underlined *Italic*
Palatino **Bold** Underlined *Italic* Compressed
ZapfChancery Bold Underlined Italic Compressed

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Alps ALQ200

Dot matrix (24 pins) 10 **$695**	240 rated 123 default 79 quality 10 12 17	Bold Comp DS Ital DblHi HTab Just	NLQ S/S UL PS VFL VLH VTab	72	IBM low EpFX, EpJX, EpLQ EpFX, EpLQ	Epson FX emulation



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Draft Bold Underline Compressed *It*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compressed *It*

Alps ALQ300

Dot matrix (24 pins) 18 **$995**	240 rated 123 default 123 default (nc) 79 quality 10 12 17	Bold Comp DS Ital DblHi HTab Just	NLQ S/S UL PS VFL VLH VTab	72	IBM low EpJX, EpLQ, IBMPro EpLQ, IBMPro	IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. –
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic Co
Proportional Bold Underline Compress
High Speed Bold Underline Compres

Alps P2400C

Dot matrix (24 pins) 18 **$1,395**	360 rated 170 default 153 default (nc) 78 quality 10 12 17	Bold Comp DS Ital DblHi HTab Just	NLQ S/S UL PS VFL VLH VTab	72	IBM low EpFX, EpJX, EpLQ EpLQ	Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. –
Draft Bold Underline Compressed *It*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compressed *It*

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

AMT 250 Office Printer

Dot matrix (18 pins)
13.2
$1,845

250 rated
180 default
153 default (nc)
38 quality

10
12
17

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

69

IBM low, IBM high
D630
D630

Graphics are incompatible with our tests.

```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compresse
Proportional Bold Underline Com
High Speed Bold Underline Comp
```

Axonic ThinWrite 100

Dot matrix (9 pins)
10
$499

100 rated
80 default
16 quality

5
10
12
17

Bold	NLQ
Comp	SmCap
DS	S/S
Ital	UL
	PS
DblHi	VFL
HTab	VLH
	VTab

66

IBM low
EpFX, IBMPro
EpFX, IBMPro

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed It
Elite Bold Underline Compressed It
Proportional Bold Underline Comp
```

Brother M-1709

Dot matrix (9 pins)
16
$699

200 rated
127 default
118 default (nc)
34 quality

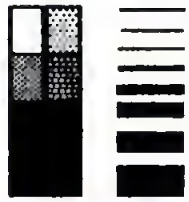
10
12
17

Bold	NLQ
DS	
	UL
	PS
DblHi	VFL
HTab	VLH
	VTab

75

IBM low, IBM high
EpFX80, IBMPro
EpFX, IBMPro

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic C
Proportional Bold Underline Compr
```

Brother M-4018

Dot matrix (18 pins)
16.5
$1,695

400 rated
258 default
236 default (nc)
40 quality

10
12
15

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

73

IBM low, IBM high
EpFX80, IBMPro
EpFX80, IBMPro

IBM Proprinter emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic C
Proportional Bold Underline Compr
High Speed Bold Underline Compres
```

Brother Twinriter 6

Dot matrix (9 pins) Daisy Wheel
16.5
$1,395

200 rated (dm)
99 default (dm)
38 rated (dw)
31 default (dw)

10
12
15

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

74

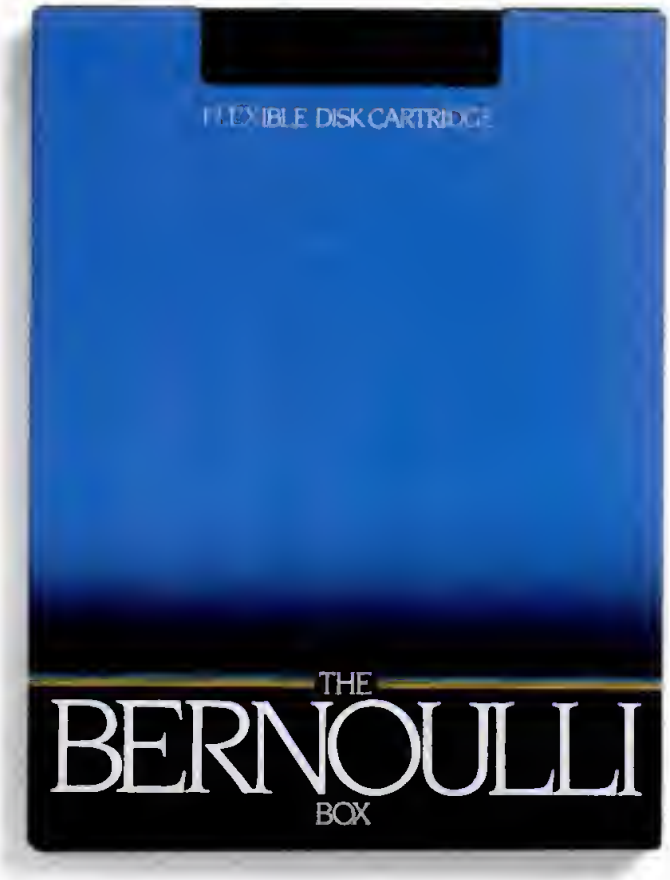
IBM low, IBM high
EpFX80, IBMGr
D630, EpFX80, IBMGr

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed I
Elite Bold Underline Compressed Itali
Proportional Bold Underline Compressed I
High Speed Bold Underline Compre
```

THE NEVER ENDING STORAGE.



It wasn't long ago that Iomega introduced the world to Bernoulli Technology,™ and computer users to the never-ending storage of the Bernoulli Box.® It was the beginning of a storybook romance. Today the Bernoulli Box provides unlimited data storage and hard disk speed for well over 125,000 devoted suitors.

Now Iomega is proud to announce a small addition to the Bernoulli Family of data storage products. One with a big future.



The Bernoulli Box II fits easily below your PC monitor.

INTRODUCING THE NEW BERNOULLI BOX II.™

Though the Bernoulli Box II is 100% Bernoulli, it's just a fraction of the original Bernoulli Box size. So no parking space is needed. It can fit neatly between your monitor and computer. Or you can install a Bernoulli Drive II™ in one of your disk drive slots.

The new 5¼" Bernoulli Box II Cartridges slip into your coat pocket as easily as a couple of floppy disks. Yet each 20MB Cartridge holds as much data as 59 floppies.



You can install a Bernoulli Drive right in a PC or PS/2 drive slot.*

Though trimmer in size, the Bernoulli Box II has all the traits that put the Bernoulli Family of drives in a class beyond hard disks, floppies or tape. The same traits that have just won the Bernoulli Box the *PC World* "World Class Product" award for the third straight year. Traits like unlimited expandability, simple portability, unbeatable security and easy backup.

Sales Offices Stamford, CT 203-351-9900, Laguna Hills, CA 714-855-1211, San Jose, CA 408-436-4922, Englewood, CO 303-740-6659, Atlanta, GA 404-261-7815, Schaumburg, IL 312-397-4234; Framingham, MA 617-620-9090, Columbus, OH 614-866-9421; Dallas, TX 214-458-2534, Arlington, VA, 703-486-5290, Toronto, Canada, 416-363-6032, Brussels, Belgium 01132-2-720-9916.

NEW POCKET EDITION.

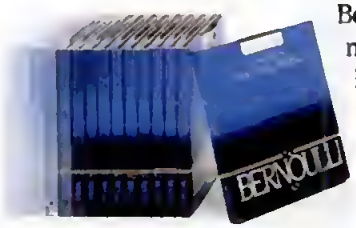


THE BERNOULLI EDGE.

Because Bernoulli uses removable 20MB Cartridges, your data storage is limitless, unlike hard disks. Whether you need 20MB or 500MB, all you have to do is add enough Cartridges. If you need more storage, or want to manage another project, just slip in another Cartridge.

Sharing your data is as simple as removing a Cartridge and carrying it or mailing it where you want it to go.

Data security is maximum with Bernoulli. Just remove the Cartridge and lock your data away in a secure place.



Handy 5¼" 20MB Cartridges give you never-ending data storage.

Bernoulli's dual-drive systems have always provided the fastest backup in the world. Now, using Bernoulli Backit™ software† that comes with single drive Bernoulli Box subsystems, you can meet your storage and backup needs in just one drive. And you can work directly from your backup.

Whether as the ideal primary storage device, as an extension of your hard disk, or as a backup device that makes tape seem obsolete, the new Bernoulli Box II is an investment that will pay big dividends. Whether you choose the popular 8" Bernoulli Box or the new 5¼" Bernoulli Box II for your storage needs, Bernoulli will grow with you.

BERNOULLI TECHNOLOGY.

Products that display this logo are compatible with Bernoulli products.

Get the never-ending storage of Bernoulli. For information, see your local Authorized Reseller, or call 1-801-778-3000.

IOMEGA®

Free one-year limited warranty on the Bernoulli Box. Special second-year warranty available for just $129.95. Warranty is on Bernoulli Box and adapter only.
*Models 60 and 60 only. †Bernoulli Backit is developed and designed by Gazelle Systems, a leader in backup software. ©1987 IOMEGA Corporation 1821 West 4000 South Roy, Utah 84067

CIRCLE 378 ON READER SERVICE CARD

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

CIE TriPrinter CI3500 Model 20

Dot matrix (9 pins)
16.5
$1,995

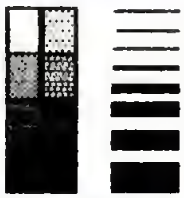
400 rated
250 default
257 default (nc)
72 quality
10
12
17.5

Bold	NLQ
Comp	
	S/S
Ital	UL
Cen	PS
	VFL
HTab	VLH
	VTab

74

IBM low, IBM high
IBMPro
IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - Draft Bold Underline Compressed Ita Elite Bold Underline Compressed Italic (Proportional Bold Underline Comp High Speed Bold Underline Compressed Ita

Citizen Tribute 224

Dot matrix (24 pins)
16
$949

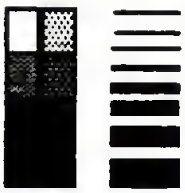
200 rated
91 default
91 default (nc)
56 quality
5 12
6 16.7
8.3
10

Bold	NLQ
Comp	
Ital	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

75

IBM low
EpFX, Tosh
EpFX, D630, Tosh, QS11

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - Draft Bold Underline Compressed Ita Elite Bold Underline Compressed Proportional Bold Underline Compresse High Speed Bold Underline Compres

C. Itoh C-715A

Dot matrix (24 pins)
15.5
$1,295

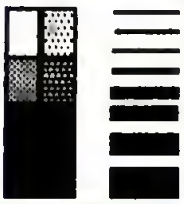
300 rated
145 default
138 default (nc)
64 quality
10
12
15
16.7

Bold	NLQ
Comp	SmCap
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

79

IBM low
EpLQ
EpLQ

Epson LQ emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - Draft Bold Underline Compressed It Elite Bold Underline Compressed Itali Proportional Bold Underline Compre High Speed Bold Underline Compres

C. Itoh C-815

Dot matrix (24 pins)
16
$1,995

570 rated
195 default
195 default (nc)
96 quality
10
12

Bold	
Ital	UL
Cen	PS
DblHi	VFL
HTeb	VLH
Just	VTab

78

IBM low, IBM high
IBMPro, Tosh
IBMPro, Tosh

IBM Proprinter emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben Draft Bold Underline Compressed Ita Elite Bold Underline Compressed Itai Proportional Bold Underline Compre High Speed Bold Underline Compress

C. Itoh ProWriter C-310 CXP

Dot matrix (9 pins)
8.5
$749

300 rated
177 default
31 quality
5 17.1
6 20
8.5
10
12

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTeb	VLH
	VTeb

72

IBM low, IBM high
EpFX80, EpJX, IBMPro
EpFX80, EpJX, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. - Draft Bold Underline Compressed It Elite Bold Underline Compressed Italic Co Proportional Bold Underline Compressed I High Speed Bold Underline Compressed Ita



YOUR PC WANTS YOU TO GIVE IT THE SAME ADVANTAGE YOU GIVE YOUR TAPE DECK AND VCR.

It's only fair. Not to mention logical. PC's want to perform as well as all your other sophisticated electronic equipment. If you're like millions of informed people throughout the world, you rely on the ultimate in audio and video recording performance. You rely on TDK.

Well, you should also rely on TDK when it comes to your computer. TDK's Floppy Disks provide the same consistently high performance. The same level of absolute quality. Which is understandable since all TDK products share an unparalleled level of technical superiority that spans over 50 years.

In fact, TDK is the world's largest manufacturer of magnetic media.

What's more, they're also a major producer of electronic component parts, including the most sophisticated heads for disk drives. What a strategic advantage! With vital "inside" information like that, it's no wonder their disks provide error-free performance.

So, if you want to put a smile on your computer's face, choose from TDK's family of 5.25-inch standard, 5.25-inch High Density and 3.5-inch No-Risk™ Disks. It's to you and your PC's advantage.

TDK®

THE NO-RISK™ DISK.



Northeastern Region: 516-625-0100; Southern Region: 404-948-1346; Midwestern Region: 312-676-5356; Western Region: 714-863-1844

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CIRCLE 134 ON READER SERVICE CARD

Dot Matrix

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

C. Itoh ProWriter jr. Plus

Dot matrix (9 pins)
10
S
6
8.S
10
12
17
$369

160 rated
72 default
20 quality

Bold	NLD
Comp	
	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

76

IBM low
EpFX80, IBMCol
EpFX80, IBMGr

Epson FX emulation





Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed *Italic*
Elite Bold Underline Compressed *Ital*
Proportional **Bold** Underline Compre
High Speed **Bold** Underline Compressed *Italic* Compre

Epson FX-86E

Dot matrix (9 pins)
8.S
10
12
17
20
$499

200 rated
129 default
41 quality

Bold	NLD
Comp	
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

78

IBM low, IBM high
EpFX80, IBMGr, IBMPro
EpFX80, IBMGr, IBMPro

Epson FX





Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed Ita
Underline Compressed ItalicCompressed s
Proportional **Bold** Underline Compresse
High Speed **Bold** Underline Compress

Epson FX-286E

Dot matrix (9 pins)
14.4
10
12
17
20
$699

200 rated
138 default
129 default (nc)
43 quality

Bold	NLD
Comp	
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

78

IBM low, IBM high
EpFX80, IBMGr, IBMPro
EpFX80, IBMGr, IBMPro

Epson FX





Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed *Ita*
Elite **Bold** Underline Compressed *Italic* Co
Proportional **Bold** Underline Compre
High Speed **Bold** Underline Compress

PC Epson LQ-850

Dot matrix (24 pins)
10.1
10
12
17.1
$799

220 rated
153 default
67 quality

Bold	NLD
Comp	
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

71

IBM low, IBM high
EpLD, IBMPro
EpLD, IBMPro

IBM Proprinter emulation





Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed *Ita*
Elite **Bold** Underline Compressed *Italic* Co
Proportional **Bold** Underline Compressed *Ita*
High Speed **Bold** Underline Compress

PC Epson LQ-1050

Dot matrix (24 pins)
10.1
10
12
17.1
$1,099

220 rated
163 default
153 default (nc)
68 quality

Bold	NLD
Comp	
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

72

IBM low, IBM high
EpLD, EpMX, IBMPro
EpLQ, EpMX, IBMPro

Epson MX emulation





Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
raft **Bold** Underline Compressed *Ital*
Flite **Bold** Underline Compressed *Italic* Co
Proportional **Bold** Underline Compressed *Ita*
High Speed **Bold** Underline Compress

Before you decide
on a PC printer
reflect on this:

Dicomix is about
to make another
small, quiet
announcement.



The KODAK DATASHOW™ System for projection of PC images.

Imitations come and go, but the original from Kodak continues to lead in quality and convenience.

Used with an overhead projector, the Datashow system converts your PC into an interactive, big-screen presentation tool, free of image distortion found in others.

And, unlike some, it permits simultaneous display of real-time images on the PC monitor and projection screen.

This Kodak system also lets you manage presentations with exclusive, multi-use software, wireless remote control, and, new from Kodak, additional software for remote control of application programs like Lotus 1-2-3.

Nobody but Kodak offers a package like that!

This portable system is easy to interface with IBM PCs and 100% compatibles, or with Apple II computers using our simple external adapter.



So why settle for an imitation? Get the genuine Datashow system, backed and serviced by Kodak. Call 1 800 44KODAK (1 800 445-6325), Ext 875, for product and dealer information.

NO OTHER SYSTEM EQUALS THE DATASHOW SYSTEM FROM KODAK

The new vision of Kodak

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CIRCLE 344 ON READER SERVICE CARD

Dot Matrix

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Epson LQ-2500

Dot matrix (24 pins)
14.3
$1,399

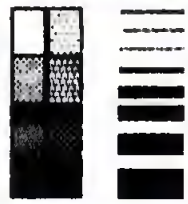
270 rated
133 default
120 default (nc)
67 quality
10
12
17.1
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

79

IBM low, IBM high
EpLQ, EpMX, IBMPro
EpLQ, EpMX, IBMPro

Epson MX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compressed *Ita*
High Speed Bold Underline Compress

Epson LX-800

Dot matrix (9 pins)
8.5
$269

150 rated
105 default
27 quality
10
12
17
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	
	VFL
HTab	VLH
Just	VTab

79

IBM low, IBM high
EpFX, IBMPro
EpFX, IBMPro

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Comp
High Speed Bold Underline Compress

Facit B3100

DOT matrix (9 pins)
10 66
$695

250 rated
149 default
41 quality
10
12
15
17

Bold	NLQ
Comp	
	S/S
Ital	UL
	PS
OblHi	VFL
HTab	VLH
	VTab

71

IBM low, IBM high
EpFX, IBMPro
EpFX, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic
Proportional Bold Underline Comp
High Speed Bold Underline Compres

Facit B3150

Dot matrix (9 pins)
10 66
$895

250 rated
154 default
153 default (nc)
44 quality
10
12
15
17

Bold	NLQ
Comp	
	S/S
Ital	UL
	PS
OblHi	VFL
HTab	VLH
	VTab

71

IBM low, IBM high
EpFX, IBMPro
EpFX, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed *It*
Elite Bold Underline Compressed *Itali*
Proportional Bold Underline Compressed
High Speed Bold Underline Compre

Facit B3350

Dot matrix (18 pins)
16.33
$995

200 rated
136 default
135 default (nc)
75 quality
10
12
15
17

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
DblHi	VFL
HTab	VLH
	VTab

76

IBM low, IBM high
EpFX, EpJX, IBMPro
EpFX, EpJX, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed *It*
Elite Bold Underline Compressed *Itali*
Proportional Bold Underline Compressed
High Speed Bold Underline Compre

Dot Matrix

TYPE / MAX PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Fortis DM1310

Dot matrix (9 pins) | 10 | $299

130 rated
93 default
25 quality

10
12
17
20

Bold	NLQ
Comp	SmCap
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

69

IBM low
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



```
Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes.  -Ben
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic Co
Proportional Bold Underline Compressed .
High Speed Bold Underline Compressed Ital
```

Fujitsu DL2600

Dot matrix (24 pins) | 16.5 | $1,495

240 rated
170 default
162 default (nc)
78 quality

10
12
18

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Can	PS
DblHi	VFL
HTab	VLH
Just	VTab

71

IBM low, IBM high
D630, EpFX80, EpJX, IBMGr
D630, EpFX, EpJX, IBMGr

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed Ita
Proportional Bold Underline Compressed Italic
High Speed Bold Underline Compressed Ita.
```

Fujitsu DL3400

Dot matrix (24 pins) | 16.5 | $995

240 rated
143 default
142 default (nc)
59 quality

10
12
17.1

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Can	PS
DblHi	VFL
HTab	VLH
Just	VTab

72

IBM low, IBM high
D630, EpFX8D, EpJx, IBMGr, IBMPro
0630, EpFX, EpJX, IBMGr, IBMPro

IBM Proprinter emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
raft Bold Underline Compressed Ital
Proportional Bold Underline Compressed
High Speed Bold Underline Compressed
```

Fujitsu DX2300

Dot matrix (9 pins) | 10 | $645

270 rated
129 default
38 quality

10
12
15
17.1
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

69

IBM low, IBM high
EpFX80, EpJX, IBMGr, IBMPro
EpFX8D, EpJX, IBMGr, IBMPro

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic Co
Proportional Bold Underline Compressi
High Speed Bold Underline Compress
```

Fujitsu DX2400

Dot matrix (9 pins) | 15 | $845

270 rated
157 default
132 default (nc)
42 quality

10
12
15
17.1
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

68

IBM low, IBM high
EpFX8D, EpJX, IBMGr, IBMPro
EpFX8D, EpJX, IBMGr, IBMPro

IBM Proprinter emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes.  -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic Co
Proportional Bold Underline Compressi
High Speed Bold Underline Compress
```



Your logical choice for printer & data sharing.

It's your choice.
Now you can give every PC user in your office *freedom of choice*: the choice to send their output to any printer — serial or parallel — anytime.
And all you need is *The Logical Connection*™ Version 3.0.

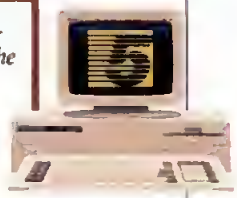


Instant switching.
Just "pop-up" the *memory resident* switching menu, cursor-point to the device you want to switch to, and press *ENTER*.
The Logical Connection handles all the print spooling, protocols and parallel/serial conversion automatically.

Preset configurations.
10 Preset configurations give multiple computers unlimited "switch and share" access to printers, plotters and modems — and each other.
Just cursor-point to a graphic "picture" of the configuration you want and download it with a couple of keystrokes, using any IBM-PC™ or compatible. If you need a *custom* configuration, you can easily modify one of the *presets* — or create your own.



Why network if you don't need to?
For peripheral sharing applications *The Logical Connection* can outperform a LAN, right out of the box — at a far lower cost.
The Logical Connection lets minicomputers and mainframes share peripherals with PCs. Or, let many devices share a single expensive modem connection.
And for really *big* applications, you can "daisy-chain" up to 45 *Logical Connection* boxes together, up to 3/4 of a mile apart.





In April, 1987 *PC Magazine* named **The Logical Connection** "Editor's Choice among *all* printer sharing devices reviewed." Author Winn L. Rosch called it ". . . more than logical — maybe inspired!"

An easy choice.
The Logical Connection is easy to set up and easy to use. Best of all, it's easy on the pocketbook. For price performance and ease of use, nothing else even comes close.



So if you're looking for the *best* way to share your valuable computers and peripherals, there's only one logical choice. Get the logical connection today.
For the name of your nearest dealer, or to order direct, call *Fifth Generation Systems at* **1-800-225-2775.**



Fifth Generation
SYSTEMS, INC.
Innovative Products Using Today's Technology

SALES:
2691 Richter Ave., Suite 107, Irvine, CA 92714
(800) 225-2775 • (714) 553-0111

*The Logical Connection is a trademark of Fifth Generation Systems, Inc. - IBM-PC is a trademark of International Business Machines, Inc.
*This product is in no way associated with or has originated in Fisher Scientific or Allied Corporation

CIRCLE 286 ON READER SERVICE CARD

Dot Matrix

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Genicom Centronics Printstation 220

Dot matrix (9 pins)
18
$599

180 rated
99 default
91 default (nc)
28 quality

5 17
6 20
8.5
10
12

Bold | NLQ
Comp
S/S
Ital | UL
PS
VFL
HTab | VLH
VTab

72

IBM low
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic C
Proportional Bold Underline Compr
High Speed Bold Underline Compres

Hewlett-Packard PaintJet

Ink jet (color)
8.5
$1,395

187 rated
78 default

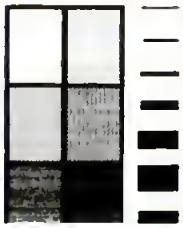
10
12
18

Bold
UL
VFL
VLH

>50

IBM low, IBM high
HPLJ, HPQJ, HPThJ
HPLJ, HPQJ, HPThJ

HP LaserJet emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic
Proportional Bold Underline Comp
High Speed Bold Underline Compress

Honeywell Bull 4/66

Dot matrix (18 pins)
11
$2,400

400 rated
235 default
218 default (nc)
63 quality

10
12
15
17.1
20

Bold | NLQ
DS | S/S
UL
DblHi | VFL
HTab | VLH
VTab

72

IBM low, IBM high
EpFXseries, IBMPro
EpFX80, IBMPro

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic Co
Proportional Bold Underline Comp
High Speed Bold Underline Compress

IBM Proprinter II

Dot matrix (9 pins)
11
$549

240 rated
129 default
32 quality

5
6
8.5
10
12
17.1

Bold | NLQ
Comp | SmCap
DS | S/S
UL
PS
DblHi | VFL
HTab | VLH
VTab

74

IBM low, IBM high
IBMPro
IBMPro

IBM Proprinter



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Ital
Proportional Bold Underline Compresse
High Speed Bold Underline Compressed It

IBM Proprinter X24

Dot matrix (24 pins)
11
$799

200 rated
172 default
68 quality

5
8
8.5
10
12
17.1

Bold | NLQ
Comp
S/S
UL
PS
DblHi | VFL
HTab | VLH
VTab

74

IBM low, IBM high
IBMPro
IBMPro

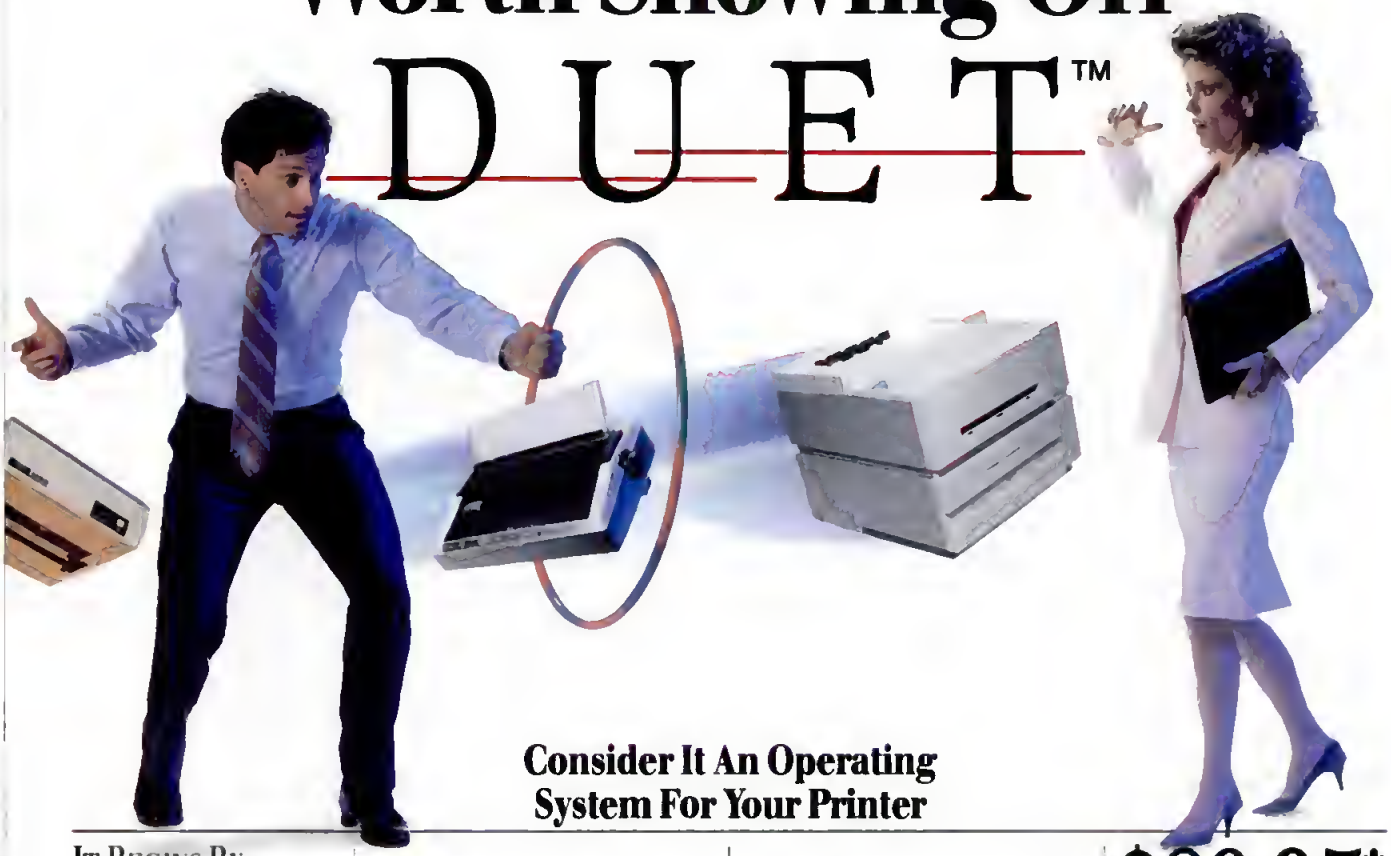
IBM Proprinter



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Ital
Proportional Bold Underline Compress
High Speed Bold Underline Compress

Introducing Printer Control Worth Showing Off

DUET™



Consider It An Operating System For Your Printer

IT BEGINS BY MAKING *RESIDENT* ONSCREEN PRINTER CONTROL A REALITY... AND THEN IT GOES A WHOLE LOT FURTHER.



Just because you need to print something sideways... doesn't mean you have to turn your whole world upside down!

We've out-sidewaysed Sideways™ ...and that's only one part of Duet! Duet decodes and prints spreadsheets and text sideways in the background...while you and your computer go off in other directions...together!

When you swear at your printer... does that help you remember how to get it into compressed mode?

Duet's pop-up menu allows you to select compressed print or double width, letter quality or draft. You can change spacing, choose a font or easily command whatever else your printer has to offer. You can even advance your paper a page or a line at a time without having to approach your hardware. On laser printers you can choose between landscape and portrait modes, select paper tray and lots more. And you'll never have to memorize escape sequences to do it. Duet can make your word processor, spreadsheet or database report generator do things with the printer it never knew was possible.

When you need to stack up a bunch of files to be printed, do you ever feel like you're just groping in the dark?

With Duet, you can see a list of what's waiting to be printed, any time you want. You even have the ability to go in and shuffle things around, cancel files and individually configure print jobs for sideways or normal print.

Power failure? Printer jam?

Anyone who's been around printers for a while knows the feeling of groping around for a power switch while paper flies in all directions and the print head bores a hole in your masterpiece. That's why Duet saves print queues to disk. When you bring the power up again, or clear the confetti out of your printer, you'll be able to restart wherever you left off...or even back up a page or two if necessary.
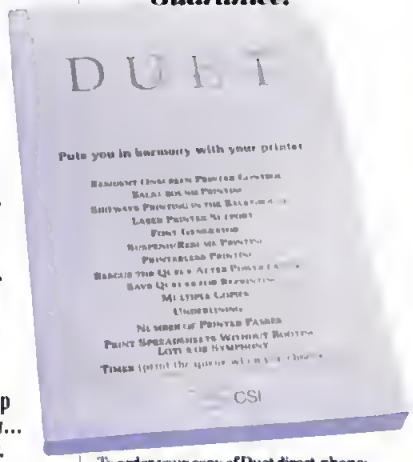
Have you ever been forced out of your own office because someone came to visit while your printer was hammering away?

Duet lets you quiet your printer with a keystroke, and then start up again when it's convenient for *you*... and you'll never miss a character.

With all of its power, Duet is so easy to use that in five or ten minutes, it will feel like an old friend. And like any true friend, it's never intrusive. Depending on how you configure it, Duet can occupy as little as 60K of RAM.

$89.95*

60-Day Money-Back Guarantee!



To order your copy of Duet direct, phone: **800-645-5501** or, in California dial **800-556-6699**. Or mail us your name and address along with a check, money order, or your Visa, MasterCard or American Express number and expiration date. *California residents, please add sales tax (6½%). For orders outside of the U.S. please add $15. CSI, 756 Chestnut Street, Santa Cruz, CA 95060. **408/426-7311**

CSI is the original developer of The Spreadsheet Auditor, and the producer of the premier LAN electronic mail system: The Network Courier.

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CIRCLE 213 ON READER SERVICE CARD

Dot Matrix

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

IBM Quietwriter III

Thermal transfer
16.5
$1,699

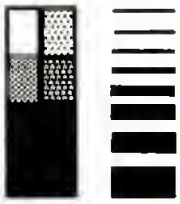
160 rated
81 default
71 default (nc)
64 quality
10
12
17.1

Bold	NLQ
Comp	
DS	S/S
	UL
	PS
	VFL
HTab	VLH
	VTab

56

IBM low, IBM high
IBMPro
IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic
Proportional Bold Underline Compressed
High Speed Bold Underline Compres

Mannesmann Tally 87

Dot matrix (9 pins)
6
$599

200 rated
113 default
33 quality
10
12
17

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

69

IBM low, IBM high
EpFX60, I6MGr, IBMPro
EpFX60, IBMGr, IBMPro

Epson FX amulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic
Proportional Bold Underline Compr
High Speed Bold Underline Compres

Mannesmann Tally 90

Ink Jet
8
$799

220 rated
101 default
74 quality
5
10
8.1
16.3

Bold	NLQ
Comp	
DS	S/S
	UL
	VFL
HTab	VLH
	VTab

61

IBM low, IBM high
IBMPro
IBMPro

IBM Proprinter amulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed It
Proportional Bold Underline Comp
High Speed Bold Underline Compres

Mannesmann Tally 330

Dot matrix (24 pins)
16
$1,799

300 rated
190 default
162 default (nc)
67 quality
10
12
15
17.1

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	PS
OblHi	VFL
HTab	VLH
Just	VTab

71

IBM low, IBM high
EpFX60, I6MPro
EpFX60, IBMPro

IBM Proprintar amulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Ita
Proportional Bold Underline Compress
High Speed Bold Underline Compress

NEC Pinwriter P9XL

Dot matrix (24 pins)
13.6
$1,795

330 rated
157 default
138 default (nc)
90 quality
10
12
15
17
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
Cen	PS
OblHi	VFL
HTab	VLH
Just	VTab

68

IBM low, IBM high
EpLQ
0630, EpLQ

Epson LQ amulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Itali
Proportional Bold Underline Compresse
High Speed Bold Underline Compressed I

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Nissho NP-2405

Dot matrix (24 pins)
15
$1,295

250 rated
143 default
138 default (nc)
65 quality

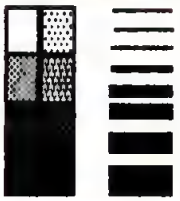
10
12
15
171
18
20

Bold	NLQ
Comp	
	S/S
Ital	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

72

IBM low, IBM high
D630, EpLQ
D630, EpLQ

Epson LQ emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed *It*
Elite Bold Underline Compressed *Italic C*
Proportional Bold Underline Compressed
High Speed Bold Underline Compres

Okidata Microline 393

Dot matrix (24 pins)
14
$1,399

450 rated
170 default
177 default (nc)
111 quality

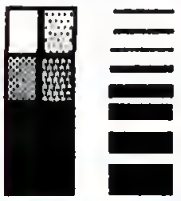
10
12
17

Bold	NLQ
Comp	
	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

72

IBM low, IBM high
EpLQ
EpLQ

Epson LQ emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed *I*
Elite Bold Underline Compressed *Itali*
Proportional Bold Underline Compress
High Speed Bold Underline Compressed Italic Compress

Olympia NP30

Dot matrix (9 pins)
10
$299

130 rated
93 default
25 quality

5 17.1
6 20
8.5
10
12

Bold	NLQ
Comp	
	S/S
Ital	UL
	PS
	VFL
HTab	VLH
Just	VTab

73

IBM low, IBM high
EpFX85, IBMGr, IBMPro
EpFX85, IBMGr, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic C*
Proportional Bold Underline Compr
High Speed Bold Underline Compres

Olympia NP80

Dot matrix (9 pins)
10
$499

200 rated
142 default
40 quality

5
6
10
12
17
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
ObiHi	VFL
HTab	VLH
	VTab

75

IBM low, IBM high
EpFX, IBMGr, IBMPro
EpFX, IBMGr, IBMPro

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Italic
Proportional Bold Underline Comp
High Speed Bold Underline Compres

Olympia NP136

Our constitution is in actual

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

OTC TriMatrix 850XL

Dot matrix (9 pins)
16
$2,395

850 rated
307 default
160 default (nc)
53 quality

S 16.6
6 18.2
8.3
10
12

Bold | NLQ
Comp
S/S
UL
VFL

76

IBM low
EpFX, IBMPro
EpFX, IBMPro

IBM Proprinter emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes. -
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Italic
Proportional Bold Underline Comp
High Speed Bold Underline Compres
```

Panasonic KX-P1080i

Dot matrix (9 pins)
9
$259

120 rated
90 default
23 quality

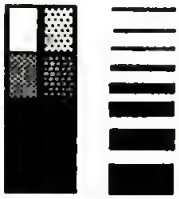
5 1S
6 17.1
7.5
8.S
10
12

Bold | NLQ
Comp
DS | S/S
Ital | UL
Cen | PS
DblHi | VFL
HTab | VLH
Just | VTab

74

IBM low, IBM high
EpFX80, IBMGr
EpFX, IBMGr

Epson FX emulation



```
Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes. -Ben
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed Ital
Proportional Bold Underline Compr
High Speed Bold Underline Compres
```

Panasonic KX-P1091i

Dot matrix (9 pins)
9
$289

160 rated
99 default
28 quality

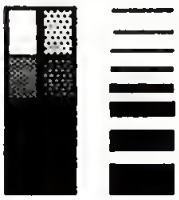
10
12
15
17

Bold | NLQ
Comp
DS | S/S
Ital | UL
Cen | PS
DblHi | VFL
HTab | VLH
Just | VTab

71

IBM low, IBM high
EpFX80, IBMPro
EpFX, IBMPro

Epson FX emulation



```
Our constitution is in actual
operation; everything appears
to promise that it will last;
but in this world nothing is c
ertain but death and taxes. -
Draft Bold Underline Compressed It
Proportional Bold Underline Compr
High Speed Bold Underline Compres
```

Panasonic KX-P1092i

Dot matrix (9 pins)
8.5
$499

240 rated
113 default
37 quality

10
12
1S
17

Bold | NLQ
Comp
DS | S/S
Ital | UL
PS
VFL
HTab | VLH
VTab

73

IBM low, IBM high
EpFX80, IBMPro
EpFX80, IBMPro

IBM Proprinter emulation



```
Our constitution is in actual
operation;everything appears t
o promise that itwill last; bu
t in this world nothingis cert
ain but death and taxes. -Ben
Draft Bold Underline Compresse
Elite Bold Underline Compressed Ital
Proportional Bold Underline Co
High Speed Bold Underline Comp
```

Panasonic KX-P1524

```
Our constitution is in actual
```

COOL, QUIET POWER

SILENCER 150



ULTRA QUIET

- PC/XT compatible
- 155 watts of power
- system runs 5°-20° cooler
- 84% noise reduction

$149

TURBO-COOL 150

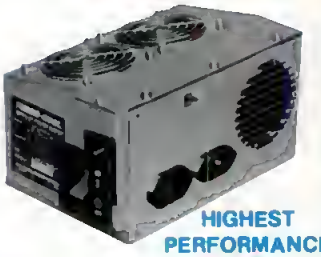


PERFECT UPGRADE

- PC/XT compatible
- 155 watts of power
- system runs 25°-40° cooler
- 50% noise reduction

$149

TURBO-COOL 200

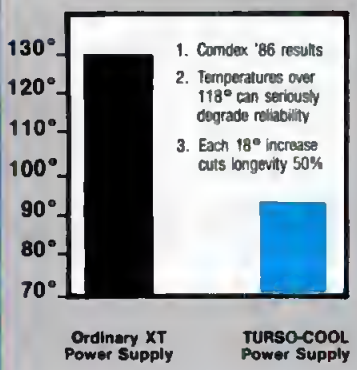


HIGHEST PERFORMANCE

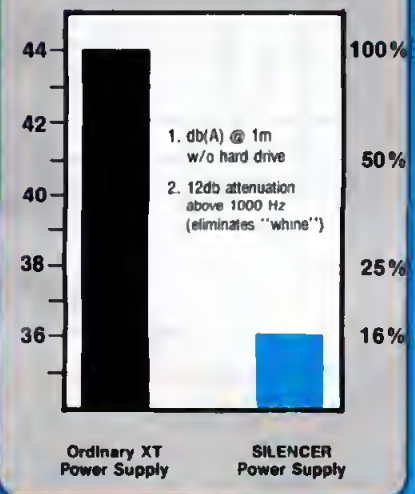
- PC/XT/XT286 compatible
- 200 watts of power
- system runs 30°-45° cooler
- standard noise level

$189

EXPANSION CARDS TEMPERATURE TEST



NOISE LEVELS



TURBO-COOL AND SILENCER POWER SUPPLIES INCLUDE THESE IMPORTANT FEATURES:

- direct replacement
- full rated power
- FCC/UL approved
- 4 drive connectors
- heavy duty components
- OV, OC, SC protection
- patented twin fan slope-nose design for max. airflow vs noise (PC/XT)
- high efficiency cooling fan with adjustable speed control (AT)
- strict quality control backed by our immediate replacement 1 yr. warranty

SILENCER 200



ULTRA QUIET

- AT compatible
- 200 watts of power
- adjustable cooling (1.0X-1.3X)
- 69% noise reduction @ 1.0X

$169

TURBO-COOL 225



HIGHEST PERFORMANCE

- AT compatible
- 225 watts of power
- adjustable cooling (1.3X-1.7X)
- 386 boards and hard drives run up to 35° cooler

$179

TURBO-COOL ADD-ON COOLING FANS



- system runs 15°-30° cooler
- improves reliability & longevity
- quick, easy installation

PC/XT $69.95
AT $79.96

ULTRA QUIET HARD DRIVES

- 30MB; 65ms; 1/2 Ht
- auto park and lock
- RLL controller
- 75% noise reduction

$419

CIRCLE 473 ON READER SERVICE CARD

SEE US AT COMDEX BOOTH B-1347

VISA/MC/COD/PO

PC COOLING SYSTEMS
31510 Mountain Way, Bonsall, CA 92003
(619) 723-9513

Dot Matrix

TYPE
MAX. PAPER WIDTH (in.)
LIST PRICE

SPEED (cps)
TYPE PITCHES (cpi)

PRINTING FEATURES
FORMATTING FEATURES

SOUND LEVEL (db)

CHARACTER SET
GRAPHICS
TEXT

GRAPHICS SAMPLES

TEXT SAMPLES

Panasonic KX-P1592

Dot matrix (9 pins)
16.5
$649

180 rated
121 default
113 default (nc)
40 quality

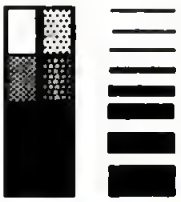
5 12
6 15
7.5 17.1
8.5
10

Bold	NLQ
DS	S/S
Ital	UL
Cen	PS
OblHi	VFL
HTab	VLH
Just	VTab

74

IBM low
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Itali*
Proportional Bold Underline Compr
High Speed Bold Underline Compress

Printronix S-7024

Dot matrix (9 pins)
18
$1,365

240 rated
151 default
135 default (nc)
59 quality

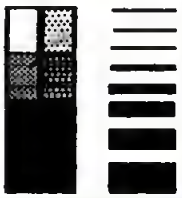
10
12
15
16.4

Bold	NLQ
Comp	
DS	S/S
	UL
Cen	PS
	VFL
HTab	VLH
Just	VTab

72

IBM low, IBM high
IBMPro
IBMPro

IBM Proprinter emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed Ita
Proportional Bold Underline Comp
High Speed Bold Underline Compress

Sanyo PR-241

Dot matrix (24 pins)
15
$999

222 rated
111 default
99 default (nc)
54 quality

5 15
6 17.1
7.5
10
12

Bold	NLQ
Comp	SmCap
DS	S/S
Ital	UL
	PS
OblHi	

72

IBM low
EpLQ, IBMGr
EpLQ, IBMGr

Epson LQ emulation



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Draft Bold Underline Compressed *Ita*
Proportional Bold Underline Compressed
High Speed Bold Underline Compress

Seikosha MP-5300AI

Dot matrix (9 pins)
15.5
$799

300 rated
190 default
177 default (nc)
48 quality

10
12
17
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

68

IBM low, IBM high
EpFX80, IBMGr
EpFX80, IBMGr

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed ItalicComp
Proportional Bold Underline Compres
High Speed Bold Underline Compress

Seikosha SK-3000AI

Dot matrix (9 pins)
10
$699

300 rated
172 default
47 quality

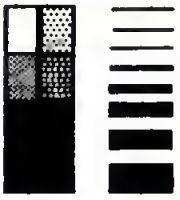
10
12
17
20

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

68

IBM low, IBM high
EpFX80, IBMPro
EpFX80, IBMPro

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compre
High Speed Bold Underline Compress



No Other Portable PC Can Make This Statement.

At 6.4 pounds, the new T1000 is the lightest portable PC in the world.

It's a good ten pounds lighter than some "portables." And you know how it feels to carry around ten extra pounds.

Yet within its diminutive footprint (it's about a foot wide and not even that deep) lies all the power of a desktop PC.

Included are 512KB of RAM and a built-in 720KB 3½" floppy drive, plus MS-DOS® 2.11 in ROM.

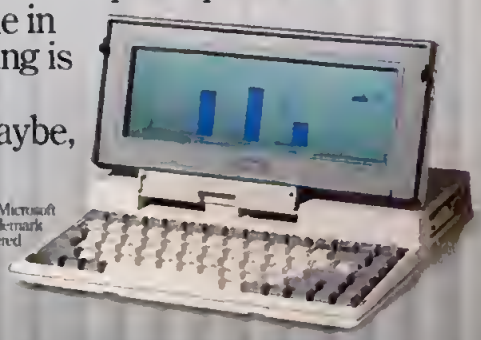
It comes with a new supertwist screen that's adjustable a full 180°, and folds flat when you want to add a CRT.

The IBM®-compatible T1000 offers you some very intelligent options. Like a numeric keypad and a 1200 bps Hayes®-compatible internal modem. Or an expansion card that will improve its memory by another 768KB.

All in all, it's the perfect way to go to work without going to work. Or to get home early, even when you'll be working late.

Call 1-800-457-7777 for the Toshiba computer and printer dealer nearest you. And see how it feels to pick up the most portable portable in the world. Nothing is as easy to take.

Except, maybe, its price.



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In Touch with Tomorrow

TOSHIBA

Toshiba America Inc. Information Systems Division

Dot Matrix

TYPE / MAX. PAPER WIDTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Seikosha SK-3005AI

Dot matrix (9 pins)
15
10 12 17 20
$899

300 rated
172 default
157 default (nc)
47 quality

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

69

IBM low, IBM high
EpFX80, IBMPro
EpFX60, IBMPro

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed Ita
Elite Bold Underline Compressed ItalicComp
Proportional Bold Underline Compre
High Speed Bold Underline Compress

Seikosha SL-80AI

Dot matrix (24 pins)
10
10 12 17 20
$549

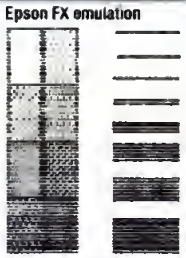
135 rated
60 default
31 quality

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

66

IBM low, IBM high
EpFX, EpLD, IBMGr
EpFX, EpLD, IBMGr

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compress
High Speed Bold Underline Compress

Seikosha SP-180AI

Dot matrix (9 pins)
10
5 10 12 17 20
$249

100 rated
51 default
16 quality

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
HTab	
	VTab

67

IBM low
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Itali*
Proportional Bold Underline Compre
High Speed Bold Underline Compress

Seikosha SP-1200AI

Dot matrix (9 pins)
10
5 10 12 17 20
$319

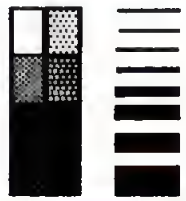
120 rated
76 default
19 quality

Bold	NLQ
Comp	
DS	S/S
Ital	UL
	PS
HTab	
	VTab

70

IBM low, IBM high
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Co
Proportional Bold Underline Compre
High Speed Bold Underline Compress

Star NB24-15

Dot matrix (24 pins)
15.5
5 6 7.5 8.6 10 12 15 17.1 20
$999

180 rated
125 default
116 default (nc)
53 quality

Bold	NLQ
Comp	SmCap
DS	S/S
Ital	UL
Cen	PS
DblHi	VFL
HTab	VLH
Just	VTab

78

IBM low, IBM high
EpLQ, IBMPro
EpLD, IBMPro

Epson LQ emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed *Ita*
Elite Bold Underline Compressed *Italic* Cc
Proportional Bold Underline Compressed
High Speed Bold Underline Compress



For people too busy to learn word processing. And too busy not to.

PFS:Professional Write is so easy you can learn it in an afternoon.

Professional Write's design is so intuitive, you may never need the manual. Pull-down menus describe all the functions, and on-line help screens are always available to handle your questions. There's no need to memorize special keys or search through confusing reference cards.

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So if you think you can't afford the time to learn word processing, think again. Maybe you can't afford *not* to. Find out how easy it is. Just call for a free trial disk, and see for yourself as you actually create and print your letter with PFS:Professional Write.



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Why you should buy a mouse with no moving parts. Now.



Several reasons. No moving parts. No problems. And $20 comes back to you.

The PC Mouse has no moving parts. It is an optical mouse. It's faster. More accurate. And so reliable, it's the only mouse with a **Lifetime Warranty.** Other mice, like the ones from IBM and Microsoft,® have a rolling ball, little teeny bearings and shafts and lots of other moving parts. Which make a mechanical mouse less reliable. Less accurate.

The PC Mouse gives you digital accuracy and superior software compatibility. PC Mouse works with any software package written for use with a mouse and quite a few that aren't. Designer Pop-up™ menus come FREE with every PC Mouse. Designer Pop-up menus include over 20 pre-configured menus for the most popular software programs, like Lotus 1-2-3. You also get an easy to use application so you can create your own menus for software programs not originally designed to use a mouse.

The PC Mouse from Mouse Systems comes in three models: PC Mouse (serial), PC Mouse Bus Plus (it comes with a serial Bus card) and our *NEW* PC Mouse for the IBM Personal System/2.™

And from September 15th through the end of December you can get $20 back.* Just send us your receipt, registration card and this ad, postmarked no later than midnight December 31, 1987 and we'll send you $20.

PC Mouse.
No moving parts.
No problems.



MOUSE SYSTEMS

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**This offer applies only to the Mouse Systems' PC Mouse product brand*

CIRCLE 350 ON READER SERVICE CARD

Dot Matrix

TYPE MAX. PAPER WIDTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Star NR-15

Dot matrix (9 pins)
14.5
$799

240 rated
151 default
138 default (nc)
42 quality

5 17
6 20
8.5 24
10 28.8
12 34
14.4

Bold	NLQ
Comp	
	S/S
Ital	UL
Cen	PS
QbIHi	VFL
HTab	VLH
Just	VTab

81

IBM low, IBM high
EpFX, IBMGr, IBMPro
EpFX, IBMGr, IBMPro

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed *It*
Elite **Bold** Underline Compressed *Italic* C
Proportional **Bold** Underline Compress
High Speed **Bold** Underline Compres

Star NX-15

Dot matrix (9 pins)
15.5
$499

120 rated
84 default
81 default (nc)
22 quality

8 24
8.5 34
10
12
17
20

Bold	NLQ
Comp	
	S/S
Ital	UL
Cen	PS
QbIHi	VFL
HTab	VLH
Just	VTab

79

IBM low, IBM high
EpFX, IBMGr
EpFX, IBMGr

Epson FX emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed *It*
Elite **Bold** Underline Compressed *Italic* C
Proportional **Bold** Underline Compress
High Speed **Bold** Underline Compres

Tektronix 4696

Ink jet
8.5
$1,795

35 rated
26 default
14 quality

10

	UL
	VFL
HTab	

60

IBM low
None
None

Graphics are incompatible with our tests

Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft Bold Underline Compresse
Proportional Bold Underline Co
High Speed Bold Underline Comp

Texas Instruments 855 Demand Document Printer

Dot matrix (9 pins)
9.5
$2,295

300 rated
195 default
60 quality

10
12
16.67

Bold	NLQ
	VFL
	VLH

81

IBM low
None
None

Graphics are incompatible with our tests.

Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Compressed Italic
Elite **Bold** Compressed Italic
High Speed **Bold** Compressed Italic

Toshiba P351C

Dot matrix (24 pins)
15
$1,599

250 rated
163 default
153 default (nc)
49 quality

10
12
16.7

Bold	NLQ
Comp	
	S/S
Ital	UL
	PS
	VFL
HTab	VLH
	VTab

72

IBM low, IBM high
IBMGr, IBMCol, IBMPro, QS11
IBMGr, IBMPro, QS11

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. –
Draft **Bold** Underline Compressed
Elite **Bold** Underline Compressed
Proportional **Bold** Underline Compr
High Speed **Bold** Underline Comp

Dot Matrix

TYPE / MAX. PAPER WIOTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Toshiba P321SL

Dot matrix (24 pins)
10
$749

180 rated
120 default
50 quality
10
12
17
28

Bold, Comp, S/S, Ital, UL, PS, VFL, HTab, VLH, VTab

71

IBM low, IBM high
IBMGr, IBMPro, QS11
IBMGr, IBMPro, QS11

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed It.
Elite Bold Underline Compressed It
Proportional Bold Underline Comp
High Speed Bold Underline Compres

Toshiba P341SL

Dot matrix (24 pins)
15
$999

180 rated
125 default
118 default (nc)
52 quality
10
12
17
20

Bold, Comp, S/S, Ital, UL, PS, VFL, HTab, VLH, VTab

68

IBM low, IBM high
IBMGr, IBMPro, QS11
IBMGr, IBMPro, QS11

IBM Proprinter emulation



Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is c ertain but death and taxes. -
Draft Bold Underline Compressed It
Elite Bold Underline Compressed Ita
Proportional Bold Underline Comp
High Speed Bold Underline Compres

Daisy Wheel

TYPE / MAX. PAPER WIOTH (in.) / LIST PRICE	SPEED (cps) / TYPE PITCHES (cpi)	PRINTING FEATURES / FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET / GRAPHICS / TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Brother HR-20

Daisy wheel
8.5
$499

22 rated
21 quality
10

Bold, DS, UL, PS, VFL, HTab, VLH, VTab

72

IBM low, IBM high
None
0630

Does not support graphics.

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Pica Bold Underline Italic Sup
Proportional Bold Underline Italic Super

Brother HR-40

Daisy wheel
15
$799

40 rated
31 default (nc)
31 quality
10

Bold, UL, PS

71

IBM low, IBM high
None
D630

Does not support graphics.

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Pica Bold Underline Italic Sup

WARNING:

If you don't buy an ALLOY error-correcting tape drive, you may be buying into trouble.



ALLOY's error-correcting Retriever™ tape drives work with IBM standards — old and new.

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Choose the Right Retriever for You

Retriever/40 packs 40 MBytes of data onto a compact DC-2000 type mini-cartridge. Designed to fit *into* your AT or compatible, or Compaq 386.™ Interchanges data with the Tape System/2.

Tape System/2™ is the 40 MByte Retriever expressly designed to fit into your IBM Personal System/2™ Model 50, 60 or 80. No controller card required. Exchanges data with the Retriever/40.

Retriever/120 gives you 120 MBytes of error correcting data storage. Works with ATs and compatibles, Compaq 386 and all models of the Personal System/2. Ideal for network backup. Attach up to 4 Retriever/120's for automatic backup or restore of up to 480 MBytes of data — unattended.

To get your own Retriever — or to get more information — see your dealer, or call ALLOY today at (617) 875-6100.

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Alloy Computer Products, Inc., 9 Executive Circle, Suite 240, Irvine, California 92714. (714) 261-7661
In Europe: Alloy Computer Products (Europe) Ltd., Tel. 0285-69571, Tlx: 43340 In Australia: Alloy Australia Pty. Ltd.. Tel. 011-613-561-4988

CIRCLE 255 ON READER SERVICE CARD

Daisy Wheel

TYPE MAX. PAPER WIOTH (in.) LIST PRICE	SPEED (cps) TYPE PITCHES (cpi)	PRINTING FEATURES FORMATTING FEATURES	SOUND LEVEL (db)	CHARACTER SET GRAPHICS TEXT	GRAPHICS SAMPLES	TEXT SAMPLES

Fortis DX41

Daisy wheel 16.6 $699	40 rated 31 default 33 default (nc) 19 quality 10 12 15	Bold Comp DS Cen HTab Just S/S UL PS VFL VLH VTab	72	IBM low, IBM high D630 D630	Diablo emulation is incompatible with our tests.	Our constitution is in actual operation; everything appears to promise that it will last; but in this world nothing is certain but death and taxes. - Pica Bold Underline Italic Supe Elite Bold Underline Italic Superscri Proportional Bold Underline Italic Super Lineprinter Bold Underline Italic Superscript

Panasonic KX-P3131

Daisy wheel 13.5 $419	17 rated 16 quality 10 12 15	Bold HTab Just UL PS VFL	72	IBM low, IBM high D630 D630	Diablo emulation is incompatible with our tests.	Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben Pica Bold Underline Italic Supe Proportional Bold Underline Italic Supers

Primage 90-GT

Daisy wheel 14 $1,095	90 rated 56 default (nc) 53 quality 10 12 15	Bold DS Cen HTab Just NLQ S/S UL PS VFL VLH VTab	69	IBM low, IBM high EpMX D630,EpFX	Epson MX emulation	Our constitution is in actual operation;everything appears t o promise that itwill last; bu t in this world nothingis cert ain but death and taxes. -Ben Pica **Bold** Underline Italic Elite **Bold** Underline Italic Proportional **Bold** Underline Italic

nc—narrow carriage



When upgrading your PC becomes the logical thing to do, ours is the only logical way to do it.

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The LOGITECH Graphics Sub-System is the only complete graphics package that works with all IBM PC's, AT's, and compatibles. It includes mouse, monitor, and EGA board.

And not just any mouse, monitor and EGA board. This is Logitech's opto-mechanical 3-button mouse which gives you excellent resolution and long-term reliability. Additionally, it plugs into the board's mouse port, freeing the serial port for laser printers and other peripherals.

The LOGITECH AutoSync Monitor has a 14" diagonal screen and is compatible with CGA, EGA, PGA as well as monochrome graphics.

As for the EGA card, it's manufactured exclusively by Logitech to provide the new high quality VGA-level 640 x 480 resolution in 16 colors, a 256K memory, and an automatic mode switch. Plus, you get our EGA-compatible Paint Show program.

And because Logitech is the leading manufacturer of mice and other hardware and software products for the PC, we can offer this bundle for only $999. Or the LOGITECH EGA & Mouse for $399. Or just the monitor for $699.

If you want enhanced graphics, better resolution, and faster, easier pointing and selecting in one fell swoop call Logitech at 800-231-7717 (800-552-8885 in California). Or send in the coupon. In Europe, call 41-21-869-9656.

It's the only logical thing to do.

Please send me: ☐ the whole bundle, ☐ the EGA & Mouse, ☐ the Monitor.
Shipping: Entire bundle $18.50, EGA & Mouse $6.50, Monitor $12.00.
California residents add applicable sales tax.
Prices valid in U.S. only.

Total enclosed $_____

☐ VISA ☐ MasterCard ☐ Check Enclosed.

Card Number_____

Expiration Date_____

Signature_____

Name_____

Address_____

City_____ State_____

Zip_____ Phone_____

LOGITECH

LOGITECH, Inc., 6505 Kaiser Drive
Fremont, CA 94555, Tel: 415-795-8500

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CIRCLE 182 ON READER SERVICE CARD

Who do you think of as the world's largest manufacturer of mice?



Wrong.

It's not the name on the tip of your tongue.

But it's the name that soon will be: Logitech.

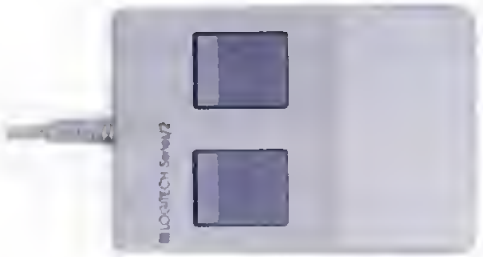
In our short history, we've manufactured over 750,000 mice. More than any other company in the world.

And we've supplied more mouse hardware, software and firmware to more major OEM's than anyone else.

And along the way, we've earned a reputation for our technological know-how in all facets of mouse production. That's because we design and manufacture our mice ourselves. We even publish our own software.

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But our achievements of the past are only a stepping stone for the future. Which is why we've designed the new LOGITECH Series 2 Mouse. It's 100% compatible with the latest IBM Personal System 2.™ And it plugs right into the mouse port, freeing the serial port for laser printers and other peripherals.



LOGITECH SERIES 2 MOUSE with Plus Software $99
Our new mouse is 100% compatible with IBM. Plus Software includes driver, programmable pop-up menu system, Point and Click Shell for 1-2-3,™ and Point, the mouse-based text editor.

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LOGITECH'S COMPLETE CADO SOLUTION $189
For beginner to advanced, it's a complete solution for dimensioned line drawing and CAOO. Package includes Mouse, Plus Software, and LOGICAOO.

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CIRCLE 133 ON READER SERVICE CARD



LASERS:

Since the introduction of the Canon-engine-based Hewlett-Packard LaserJet in 1984, desktop printing has never been the same. Easy to install and maintain, the HP LaserJet set new standards for speed (8 pages per minute), print quality (300 dots per inch), and price ($3,495). For the first time, PC users had a faster, quieter alternative to daisy wheel printers for letter-quality printing—and they didn't have to take out a second mortgage to afford it.

Like PC users, printer manufacturers knew a good thing when they saw it, and it didn't take long for HP's competitors to introduce their own, lower-priced laser printers. In 1984 we reviewed only one laser printer, the HP LaserJet; this year we've evaluated 36 machines from 26 vendors. With at least two dozen lasers in this year's roundup claiming HP compatibility and speeds of 6 to 8 pages per minute, it's easy to see that imitation is indeed the finest form of flattery.

List prices of some new laser printers start at little more than half the 1984 list price of the venerable HP LaserJet. The least expensive of this year's group is the $1,795 C. Itoh Jet-Setter, followed by the $1,895 Oasys LaserPro Express, followed by the $1,995 Okidata Laserline 6. At the high end, we've reviewed two high-resolution, high-ticket laser printers—the

A NEW STANDARD

$12,980 Printware 720 IQ Laser Imager and the $18,750 Varityper VT-600—another first for *PC Magazine*'s printer project and a tantalizing suggestion of things to come.

As the price of many laser printers has fallen, performance has risen. The original HP LaserJet used toner cartridges that had to be replaced every 3,000 pages; it had a rated speed of 8 ppm and offered only 128K of memory. Among the new printers we've reviewed, some do not need changes in consumable components for 5,000 pages or more. Print speed ratings have edged upward, with 10-ppm and 12-ppm ratings becoming more common. One new laser, the $8,395 Kyocera F-3010, attempts to redefine Mach 1 with its 18-ppm rating. More laser printers are using print engines made by vendors other than Canon, such as Hitachi, Konica, Kyocera, and Ricoh. Memory is less expensive, and some of the printers reviewed here come with as much as 3 megabytes of RAM. Gains have been made not only in raw speed but in resolution, with 600-dpi and 1,200-dpi laser printers challenging $30,000 typesetting machines.

There are also more laser printers that use PostScript, the page description language spoken by desktop publishers, and more that offer both PostScript and HP compatibility. Among those in the latter group that you'll read about are the NEC Silentwriter LC-890, the Texas Instruments OmniLaser 2115, the Laser Connection PS Jet, and the QMS PS-800 Plus. These machines may sell themselves as crossover dreams, but they still have a way to go to catch up to the preeminent PostScript laser printer, the Apple LaserWriter Plus.

HP may have started it all with the LaserJet, but the inspiration for laser print engines came from inexpensive desktop copier designs. Instead of using a paper original and optics to transfer an image to a photosensitive drum, laser printers use a small diode laser to create an image. With one notable exception, all the printers reviewed here follow this path. Instead of using a laser, the $2,495 Data Technology CrystalPrint VIII uses a strip of liquid crystal shutters (LCS) similar to the liquid crystals used in watch faces to either block or transmit light. The idea behind using LCS technology is to avoid distorting the printed image, but the resolution and quality of the output produced by LCS machines seem to differ very little from those of laser printers. And although none are represented here, some manufacturers have used arrays of light-emitting diodes (LEDs) to create a printed image. Only time will show which design is the most reliable.

Whether they use laser or LCS technol-

In only 3 years, laser printers have changed the way we think about desktop printing; now the ubiquitous office printer is a faster, cheaper laser.

Illustration: Javier Romero

ogy, all of these machines are part of the rapidly expanding page printer market. For PC users such fast growth means a greater choice among alternatives and more features for less money, but also the risk that some products will be brought to market before they're ready. As our tell-it-like-we-saw-it reviews attest, we came across our share of those during our tests.

PRINT ENGINES Different combinations of features make certain laser printers better suited to some applications than to others, so you'll need to know a few facts about the machines' print engines before you can decide which of the 36 we review here is right for you. For example, the "rated duty cycle," which is usually presented in terms of recommended pages per month and is obtainable from the manufacturers, will give you a rough estimate of how long it will be before your printer gives up its toner. Many of the printers reviewed here, including the HP LaserJet Series II, have rated duty cycles of 5,000 pages per month; others, like the Genicom 5010, have rated duty cycles of 15,000 pages per month.

There's a trade-off to be made for the claimed long life of the Genicom 5010's Hitachi print engine, however. Maintenance of machines built on this and other non-Canon print engines isn't exactly a breeze. In our reviews we point out those designs that, unlike the Canon engine's, require you to contend with separate consumable components, including toner, developer, photosensitive drum, and fusing unit. Laser printers that are based on either the new Canon LBP-SX (the HP LaserJet Series II) or the LBP-CX (the original LaserJet, Apple LaserWriter) print engines use all-in-one cartridges that contain almost all the components—toner, developer, drum—that get used up or wear out. As it turns out, when calculated on a per-page basis using the manufacturers' recommended replacement intervals, some of the separate-component systems end up costing more per page than the all-in-one approach.

PAPER HANDLING We've also looked at how these 36 newcomers handle paper. Almost all have at least one input tray, which may have a maximum capacity of 100 to 250 sheets. Some, like the Kyocera F-2010 and the Texas Instruments OmniLaser 2115, have second input trays—a handy feature if you need to load two types of paper. Other machines, like the HP LaserJet Series II and the NEC Silentwriter LC-850, feature a manual input slot that lets you feed envelopes or special paper through the printer without having to replace the paper in the trays.

More laser printers are stacking their output facedown, which means that documents are ordered correctly the first time around. The original HP LaserJet offered only faceup output, thus kicking out documents in reverse order. But because facedown output means that paper has to navigate a tight turn along the printer's paper path, laser printers that offer it may not be able to handle stiff, thick-stock paper. The most flexible laser engine designs offer both kinds of output along with a manual feed slot.

FRONT-PANEL CONTROLS Beyond supplying dual paper drawers and collated documents, laser printers are showing other signs of intelligent life. Like the HP LaserJet Series II, more laser printers have conversational 16-character LCD windows (and in English, too), although some holdouts, like the Epson GQ-3500, still provide displays with cryptic two-digit codes that stand for operating and error messages. Of course, those printers are great if you need to test your recall of trivial information.

The original HP LaserJet had a Spartan front panel—five buttons, four indicator lights, and a two-digit display. Now more laser printers offer greater access to configuration options than ever before. The front panel of the Kyocera F-2010, for example, has 14 buttons and a 10-key numeric pad; different combinations can be used to select a font or emulation, set margins, and eject a page. Other laser printers allow you to select and configure the interface ports through front-panel controls. With these options at hand, laser printers that make you set DIP switches buried deep inside their casings or that force you to set default parameters through complex strings of escape codes seem anachronistic.

All that convenience is nice, but compatibility with existing applications packages decides whether a laser printer will increase your productivity or be just a 70-pound paperweight. Because it's too time-consuming to write nonstandard printer drivers to accommodate every odd laser on the market, many applications vendors have written drivers for the HP LaserJet Plus command set. In this year's roundup, we've seen more printers that emulate the widely used LaserJet command set, as well as the popular Diablo 630 command set. IBM Proprinter and Epson emulations are also common, and a handful of laser printers are compatible with HPGL, the language of choice for HP plotters.

Intelligence, raw speed, PostScript, emulations, paper handling, resolution, longevity, and near-typeset-quality output—in varying combinations and with varying degrees of success, that's what the 36 laser printers we've evaluated have to offer. Read on to find out what our experts think of the largest and most diverse group of laser printers ever reviewed in *PC Magazine*.—**Alfred Poor**

Blaser Industries' $2,395 BlaserStar is the kind of laser printer that has much in common with its dot matrix or daisy wheel counterparts, except that it prints faster, quieter, and with laser print quality. It's aimed at those who want laser technology but don't need a page description language, built-in user-definable fonts, or yet another printer command language.

Setting up the Canon-engine BlaserStar requires little more than attaching the paper trays, inserting the toner cartridge, loading the paper, and connecting the parallel cable. One minor complication: you'll need to add a MODE command to your AUTOEXEC.BAT file. But since the manual explains the process, adding the command shouldn't be a problem.

The command (MODE LPT1:,,p) is supposed to set the computer system for infinite retries on the parallel port. It's necessary because the printer takes so long—notably when printing graphics in the HP LaserJet Plus emulation mode—that the computer may give up before the page finishes.

We ran into the resulting time-out error

even after running the MODE command. The problem lies in PC-DOS 3.20, which acknowledges the command but gives the time-out error anyway.

Blaser Industries claims to have solved this problem in a new ROM. The fix was not available in time for testing the printer, but the company has begun shipping the new ROM. We sidestepped the issue by using PC-DOS 3.1.

Surprisingly, the BlaserStar offers no way to change its default settings, either through DIP switches or through its front-panel buttons. This situation poses no problem for most settings, since you can change them through software commands and even automate the process in your AUTOEXEC.BAT file. The inability to change the default emulation, however, could pose a minor inconvenience, since no software commands can change the printer's emulation mode.

Blaser Industries has wisely avoided creating yet another native command mode. Instead, the printer can emulate the Epson FX series, the Diablo 630, or the HP LaserJet Plus. You can change easily from one emulation to another through a front-panel button, but the printer always turns on in HP LaserJet Plus mode. If you'd rather use one of the other modes most of the time, you'll have to change the setting every time you turn on the printer.

The BlaserStar's speed is disappointing. Although rated at 8 pages per minute, the printer managed only 5.5 ppm on the PC Labs speed test. Print quality is good. Graphics retain all the detail of a complicated pattern, but solid black areas look washed out.

On the PC Labs graphics test, the BlaserStar had no trouble with HP LaserJet Plus emulation. In Epson FX mode, though, the printer performed better on the Epson MX emulation test than on the Epson FX test. In the Epson FX test, the BlaserStar added a form-feed between the page header and the graphic. In the Epson MX test the printer performed without problems.

Built-in fonts on the BlaserStar include Courier (10 pitch), Prestige Elite (12 pitch), and Line Printer (16.66 pitch), all in portrait orientation. Additional fonts include Courier and Prestige Elite in italic, and Courier in landscape orientation. The IBM extended character set is available only for 10 pitch, only in portrait orientation, and only when the printer is set for Diablo 630 ECS emulation.

The printer also comes with a disk that holds six downloadable fonts, including Helvetica Bold, Line Printer, and variations on Times Roman, including italic.

The additional fonts available vary depending on the emulation mode. In Epson FX emulation, no additional fonts are available. In Diablo 630 emulation the printer can use a font cartridge designed for that mode. HP LaserJet Plus emulation offers the greatest flexibility, letting the printer use both font cartridges and downloaded fonts.

The user manual includes clearly written and illustrated instructions for setting up and operating the printer. A programmer's section includes separate, standalone chapters for each of the three emulations.

With a few hundred dollars more shaved off its price, the BlaserStar could become interesting indeed. As it is, the printer merits consideration, but too many equivalent printers in the same price range clamor for the spotlight, preventing the BlaserStar from dazzling us as a blazing star should.—**M. David Stone**

PC MAGAZINE FACT FILE



BlaserStar
Blaser Industries
6383 Arizona Circle
Los Angeles, CA 90045
(800) 322-3399
(213) 642-7771
List Price: $2,395
Dimensions (HWD): 18.5 × 16.2 × 11.4 in.
Weight: 55 lbs.
In Short: Built on the original Canon engine, this laser printer offers a speed of 5.5 ppm and good print quality, with Diablo 630, Epson FX series, and HP LaserJet Plus emulations.

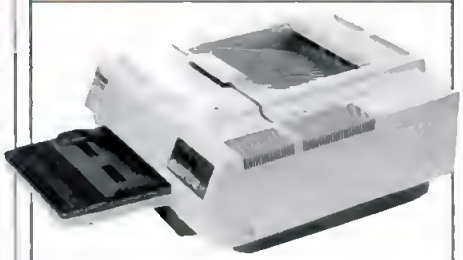
CIRCLE **642** ON READER SERVICE CARD

[redacted]

Even if you didn't know that the Canon LBP-8II costs $2,750, you'd know it's a laser—the name is the giveaway. Mention laser printers, and Canon comes immediately to mind. The company, of course, is responsible for the Canon engine used in the Hewlett-Packard LaserJet and other early laser printers for the PC market. It's also responsible for the second-generation engine used in the HP LaserJet Series II.

On the surface, the Canon LBP-8II and the HP LaserJet look like the same machine. In fact, they're packaged in the same gray shell. We timed both printers at approximately the same speed: 7.4 pages per minute for the Canon and 7.5 ppm for

PC MAGAZINE FACT FILE



Canon LBP-8II
Canon USA Inc.
One Canon Plaza
Lake Success, NY 11042
(516) 488-6700
List Price: $2,750
Dimensions (HWD): 9.1 × 19 × 17.9 in.
Weight: 44 lbs
In Short: With its new Canon engine, this laser printer offers better-than-average laser print quality as well as the expected low noise and high speed (7.4 ppm), but it's limited by poor documentation, inadequate support, and lack of common graphics emulation.

CIRCLE **457** ON READER SERVICE CARD

Photographs: Thom O'Connor

the HP. So what's the difference? For one, the list price of the Canon is $155 higher than that of the HP LaserJet Series II. But more important, because the Canon LBP-8II uses a different controller from the one in the HP LaserJet Series II, the Canon does not emulate the HP LaserJet; nor does it have at its command HP's library of font cartridges.

Given Canon's history, you'd expect something special from a printer that bears the Canon name. Well, you'd be partly right about the Canon LBP-8II. And you'd be partly wrong.

The Canon LBP-8II certainly is special when it comes to print and graphics quality and good looks. But it's marginal at best in its choice of printer emulations. And it's certainly far from special when it comes to documentation and support. Whether the good points make up for the bad depends on your needs.

Much that is good about the LBP-8II is a result of the new Canon engine. Most laser printers produce text that has a slight fuzziness on the edges of the characters, making it tend to look like a good copy rather than an original. The new Canon engine, on the other hand, produces much crisper images. The 300-dot-per-inch rating remains the same, and the characters are hard to distinguish from text pounded out by the best daisy wheel printers.

The new Canon engine is also responsible for the LBP-8II's good looks. The physical design of any laser printer is largely determined by the engine it uses. The engine in the LBP-8II results in a low profile and lends itself to a sleek, modern design.

FRONT-PANEL CONTROLS The printer's front panel includes six touch-sensitive switches, several LEDs, and an easy-to-read LCD message display. The messages are in English rather than being obscure error codes. Error messages include such informative possibilities as Paper Jam, Paper Out, and Toner Low. And when the printer is ready for use, the LCD reads Ready.

The LCD also displays the menus you navigate through to change default settings. The options include such choices as parallel or serial connection. Menu choices also let you save your changes temporarily in RAM or permanently in nonvolatile RAM. Here again, the use of words rather than obscure codes makes the Canon LBP-8II easy to use.

The printer's mechanics of paper handling is another plus. The LBP-8II comes standard with a letter-sized tray that holds 200 sheets of paper; it includes a manual feed that fits over the tray. The manual feed is adjustable, with the left and right sides coordinated so that no matter what the width of the paper, it is always centered in the feeder. Optional trays are available for legal-sized paper, A4 letter paper (210 by 297 millimeters), and executive-sized paper (7.25 by 10.5 inches).

The Canon LBP-8II certainly is special when it comes to print and graphics quality and good looks. But it's marginal at best in its choice of printer emulations.

The printer also offers a choice of paper path. Normally, a C-shaped path delivers the paper facedown on the top of the printer for automatic collating. A built-in paper tray at the back of the printer lets you use a straight-through path that delivers the paper faceup in the tray.

The Canon LBP-8II offers a supremely elegant method for choosing between the two paths. You simply open the built-in paper tray to use it, or close the tray to use the normal C-shaped path. For most purposes you'll want the automatic collating, but for envelopes you'll want to use the straight-through path to do as little damage to the envelope as possible. The straight-through path is also preferable for printing transparencies.

Built-in fonts are limited to 10-pitch Courier in medium, bold, and italic, and 15-pitch Courier, which is intended for subscripts, superscripts, and footnotes. All four fonts are available in portrait or landscape orientation, and for mixing with graphics. Character enhancements include underline, double-underline, double-high, double-wide, and inverse (white letters on a black background).

For more variety, the Canon LBP-8II has two slots for font cartridges. Currently 14 cartridges are available, at $230 to $250 each. The printer will also let you download up to 255 user-defined fonts, and it can use up to 32 fonts per page.

Other notable features of the Canon LBP-8II include the ability to print in both portrait and landscape orientation on the same page and to print multiple copies, up to a maximum of 99. In addition, the 8-ppm rating translates to a respectable 7.4 ppm on the PC Labs speed test.

LACK OF GRAPHICS One serious drawback of the printer is Canon's shortsightedness in supplying graphics emulations. The only graphics available are Canon's interpretation of the proposed ANSI standard known as VDM (Virtual Device Metafile) or CGM (Computer Graphics Metafile). Unfortunately, this proposed standard is far from common in the MS-DOS world, though some programs support it, including *PC Paintbrush*, *Halo DPE*, and several desktop publishing packages.

The sample patterns on the Canon test print suggest that the graphics can be very good indeed. But you won't see a graphics sample for this printer in the features chart because the Canon LBP-8II doesn't emulate any of the printers included on the PC Labs graphics test. According to Canon, Metro Software (Phoenix, Ariz.) sells *Printility*, a package that supplies HP LaserJet Plus emulation and Epson MX emulation for the printer. But unless you buy *Printility* ($179) or some similar package, the graphics potential of this printer is likely to remain potential—at least until support for VDM becomes more widespread.

DOCUMENTATION The other significant shortcoming of the Canon LBP-8II is its manuals. Written on the assumption that your software knows how to use the printer and that you simply have to pick the appropriate printer driver from a list, the manuals are of negligible value. That assumption is shaky at best, particularly if you have older releases of software that predate laser printers. In most cases, you

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LaserPro

can get by with using the Diablo 630 emulation mode. But you give up features that way because the Diablo mode has no command for changing fonts. With software that includes support for laser printers, though, you should be able to use most of the printer's features, because the Canon LBP-8II is upwardly compatible with the earlier Canon LBP-8A1 and LBP-8A2.

Nevertheless, the operator's manual includes beautifully illustrated instructions for unpacking the printer, loading the toner cartridge, feeding paper, and maintaining the printer. The tutorial guide gives some sample control codes and explains how to use them. But the manuals are sorely lacking in anything as useful as a list of control codes, much less explanations of each code.

Even if all your software supports the Canon printers, the lack of control codes can be a problem. Printer drivers frequently have small mistakes. If you know the control codes, you can often correct the drivers yourself. If you don't, there's not much you can do.

Canon is aware of the deficiency in the manuals and intends to correct it as soon as possible. A Canon representative suggested that if you get a printer without the new documentation for the control codes, you can simply call Canon to request a copy.

The shortcomings of the Canon LBP-8II mar an otherwise excellent printer. On the bright side, they are problems that can be fixed and that Canon promises to fix. Once the manufacturer has remedied these shortcomings, the Canon LBP-8II will be a strong candidate, in the running for your laser printer dollar.—**M. David Stone**

CIE LIPS 10 Plus

Not long ago, you couldn't buy a laser printer for under $3,000; now you can take your pick from a large field. The $2,995 CIE LIPS 10 Plus, from CIE Terminals, just makes it into that category, but it has many features that similarly priced machines lack.

Like many other printers, the LIPS 10 Plus emulates the Hewlett-Packard LaserJet Plus, Epson FX-80, and Diablo 630 printers. It comes with eight resident fonts, though most are available only in portrait mode, as well as five font outlines. It can collate paper in facedown order, and its paper tray can hold half a ream. The heavy, 82-pound machine offers both serial and parallel interfaces.

The LIPS 10 Plus's print engine, built by Konica, is rated at 10 pages per minute. It was timed at 8.9 ppm in the PC Labs speed test. More impressive than its speed is the construction of the engine itself. CIE Terminals rates it for an effective life of 600,000 pages and recommends it for up to 15,000 pages per month. That is considerably more than most other low-cost printers and could be an important factor when selecting a printer for shared use in a busy work setting. However, the Konica print engine lacks a straight-through paper path and a manual feed slot; these features make it possible to use heavier stock than can normally navigate the facedown output path.

The behavior of the LIPS 10 Plus controller bears a striking resemblance to that used by Oasys LaserPro printers. According to the configuration status sheet that the LIPS 10 Plus prints, the same codes are used by both printers for the same configuration parameters. The parameters are organized in a series of groups, each of which offers selections from a number of items. This logical grouping makes it easy to navigate through the different configuration choices.

One major advantage of the 512K LIPS 10 Plus over the Oasys models, however, is that the front panel is easier to use. Instead of showing cryptic two-character codes like the Oasys machines, the LIPS 10 Plus displays prompts in English on a large, 40-character LCD window.

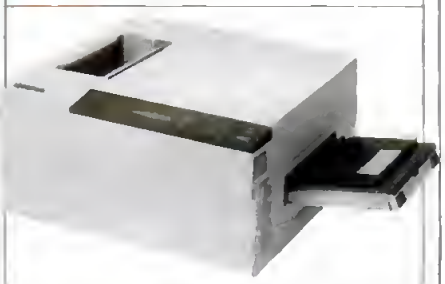
The LIPS 10 Plus command set, which is identical to the Oasys Express programming language, includes resident commands for such printing effects as graphics primitives for arcs, circles, other geometric shapes, and shadings. The programming language even supports output in 38 different bar code formats.

One of the LIPS 10 Plus command set's most powerful commands is GENF, which lets you define new character fonts as needed, based on the character outline definitions that are already resident in the printer. The definitions include fonts called Sans Serif, Roman, Gothic, and Optima-type. These definitions are then used with parameters for height, compression, shear (or angle of slant, forward or back), rotation, and boldness. The width of the stroke that produces the bold effect can be adjusted in the *x* and *y* directions separately. The quality of the resulting characters is not equal to that of downloadable fonts specifically designed for a certain set of parameters, but they are adequate for occasional use as headlines.

The LIPS 10 Plus documentation is far better than that provided with many other printers. The user manual is filled with useful illustrations and examples and shows clearly how to set up the machine. The programmer's manual explains all the LIPS commands, with plenty of examples. There are also sections for each of the three emulation modes, including tables that list the unimplemented commands for each. Both manuals are well indexed.

On the PC Labs print-quality tests, the LIPS 10 Plus produced mixed results. It had no problem with the HP LaserJet emulation commands, but the graphics it pro-

PC MAGAZINE FACT FILE



CIE LIPS 10 Plus
CIE Terminals Inc.
2505 McCabe Way
Irvine, CA 92714-6297
(800) 854-3322
(714) 660-1421
List Price: $2,995
Dimensions (HWD): 13.5 × 19.25 × 28 in.
Weight: 82 lbs.
In Short: For its speed (8.9 ppm), rugged design, powerful controller, and clear documentation, the LIPS 10 Plus is a competitive value—despite its limited paper handling, average memory (512K), and fair graphics print quality.

CIRCLE 629 ON READER SERVICE CARD

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Laser Printers: Standard Fonts

With the blurred distinction between *font* and *typeface* now firmly entrenched, it's natural to be somewhat disappointed when you first try out your new laser printer. It's a bit like cracking open a 64-color box of crayons only to find 64 shades of gray.

Rest assured, however, that laser printer manufacturers aren't taking you for the proverbial ride: 10-point Helvetica and 8-point Helvetica really are two separate fonts.

A typeface is a style of type that has been given a name, such as Courier,

Typeface

	Adobe	AvantGarde	Bandit	Bookman	Casual	Century	CIEFLEX	Courier	Dot	Dutch	EDP	Elite	Epson	Gothic	Hamilton	Helvetica
BieserStar								3				2				
Canon LBP-8II								8								
CIE LIPS 16 Plus							6	3			1	2	2			
C. Itoh Jet-Setter								2								
Cordata LP300X			1	8	1			4	1	23			13	5		25
DataProducts LZR 1230								3		1		1				
Data Technology CrystalPrint VIII								1								
Destiny Laser Act I								2								
Epson GQ-3500								2			2		2			
Geolcom Ceotronics PageProIer 8								6								
Geolcom 5010								2				2		2		
Hewlelt-Packard LaserJel Series II								4								
Kyocera F-1010								3				5		5		10
Kyocera F-2010								3				5		5		10
Kyocera F-3010								8				14		7		21
The Laser Coenectloe Big Kiss II								2				2	6	1	2	
The Leser Connectloe PS Jel								4*								4*
Mennesmann Tally 910								12				4	1	4		
NEC Silentwriter LC-850								3								
NEC Sileetwriter LC-890		4*		4*				4*								8*
Qesys LaserPro Espress								2				3	4			1
Oesys LaserPro Express Series II								2				3	4			1
Qesys LaserPro Silver Express								2				3	4	1		1
Okideta Laserllee 8								4								1
Personal Compuler Prod. Laserimege 2000								1								1
Parsonal Computer Prod. Laserimege 3000								1								1
Printronis L1012								6			2	4				
Printwere 720 IQ Leser Imager						3		1								2
QMS PS-800 Plus		4*		4*				4*								8*
QMS SmartWriter 80 Plus								2					6	3	2	
Qoedleser I								4				1				32
Qome LaserTENPlus								3								
Ricoh PC Laser 8000						2		2				2		2		
Texas Instruments QmeiLaser 2108								4*								4*
Texas Iestruments OmeiLaser 2115								4*								4*
Verityper VT-600	1*							4*								

*Typefaces for printers that are compatible with the PostScript page description language can be scaled upward from 1 to 255 points

Times Roman, or Helvetica. A font, on the other hand, is a collection of characters of a specific size and style of type, often including a character enhancement, such as bold or italic.

Most laser printers provide several fonts for each typeface they supply. This chart lists the standard fonts for each laser printer reviewed in this issue.

With some exceptions, the laser printers included in this chart store their fonts in ROM and have additional RAM available for storing downloadable fonts. Rather than storing its 110 fonts in ROM or on font cartridges or in RAM after downloading them, the Cordata LP300X stores them on six disks, requiring you to allocate approximately 3 megabytes of storage on your hard disk to contain them. The Quadlaser I has two resident fonts—Courier 10 and Courier 10 Bold. The remaining fonts must be downloaded from 14 disks. And although the QMS SmartWriter 80 Plus offers 22 resident fonts with the Epson emulation package, it offers only 19 resident fonts with the IBM Proprinter emulation package.

IBM Proprinter	Kanji	Line Printer	Modern	New Century	OCR-A	OCR-B	Palatino	PC	PI	Q-Format	Q-Prolite	Q-Roman	Q-Spreadsheet	Rule	Symbols	Taylor	Times Roman	Variitimes	Zapf	Total
		1																		6
																				8
		1																		15
		1																		3
	13							10	1					1		4				110
		1																		6
		1																		2
		1																		3
			1																	7
																				6
																				6
		2																		6
		5															8			36
		5															8			36
		14															14			78
										2		2								17
															1*		4*			13*
1																				22
															1					4
				4*			4*								1*		4*		2*	35*
		2															1			13
		2															1			13
		2				1											1	4		19
		2															8			15
		1															4			7
		1															4			7
					2	2							2							18
		1													1					8
				4*			4*								1*		4*		2*	35*
										4		2								22
								1			1		1		1		32			73
																				3
																				8
															1*		4*			13*
															1*		4*			13*
																		4*		9*

duced were disappointing. There was a small amount of toner washout in some of the gray squares of the Benday scale. More serious, though, was the fuzziness of the pinstripes and fine patterns called for by our test. The Epson mode graphics were sharp, but as in so many other lasers, the FX-80 test did not produce the correct results. The top section of the graphics was sheared off to the right. When the Epson MX-80 version of the test was used, the graphics printed correctly.

Adding toner to the LIPS 10 Plus is awkward and messy. Despite my best efforts to empty a bottle of toner into the machine's reservoir and distribute it evenly from side to side, some still spilled when I tried to close the cover of the bin. I prefer using a self-contained toner cartridge.

Overall, the LIPS 10 Plus has plenty going for it. There are other printers that have nearly identical emulation and font features that cost quite a bit less than those of the LIPS 10 Plus. There are others that are as fast. There are others still that have equivalent page-per-month ratings. But there are few that combine all three in one machine. If this combination matches your needs, the LIPS 10 Plus can represent an attractive value.—**Alfred Poor**

C. Itoh Digital Products is no stranger to any side of the printer market, having introduced high-quality machines that feature a very low price and heavy-duty high performance. For example, the $299 C. Itoh ProWriter Jr. was one of the first excellent low-end dot matrix printers, and the original $500 Apple ImageWriter (which was supplied by C. Itoh) was a dot matrix printer that was equal to the demands of the Macintosh graphics environment. And C. Itoh's original laser printer entry, the CIE LIPS 10 from CIE Terminals (then $3,495; now superseded by the $2,995 CIE LIPS 10 Plus) was an Editor's Choice in last year's printer project. So it's not surprising that the $1,795 Jet-Setter is also a trendsetter as one of the lowest-priced Hewlett-Packard LaserJet Plus–compatible laser printers around.

With its under-$2,000 list price, the Jet-Setter joins the ranks of the Oasys Laser-Pro Express ($1,895) and the Okidata Laserline 6 ($1,795). Also in that category is the street price of the HP LaserJet Series II, which has been known to go below $1,700. There's something to be said for buying equipment from authorized dealers, of course, but it's up to you to decide how much that's worth.

The C. Itoh Jet-Setter uses a Konica engine that is rated at 5 pages per minute. A cheaper version of the 10-ppm Konica used in the CIE LIPS 10 and LIPS 10 Plus laser printers, the Jet-Setter's print engine stood up to our speed test, clocking in at 4.9 ppm. However, this rating is still 1 to 3 ppm slower than that of the Canon and Ricoh engines, which are used in some similarly priced competitors. It seems odd that C. Itoh would release a machine at this stage of the game with a print engine that is slower than that of the other players. Had C. Itoh introduced a 10-ppm printer with HP Plus emulation for $1,895, or maybe even $1,995, it could have made a much bigger splash. But perhaps that's planned for next year. Back to the Jet-Setter.

Unfortunately, the first thing I noticed when I ran this large (11 by 21 by 16.6-inch) laser printer was not its speed but the noise it made. Because the noise level of laser printers is typically well under 55 decibels and is considered to be both insignificant and difficult to measure, I was surprised to hear a whirring and grinding of gears that was downright annoying when I sent a document to this one. I measured the sound level at 58 decibels, but the quality of the noise seemed to exaggerate its volume.

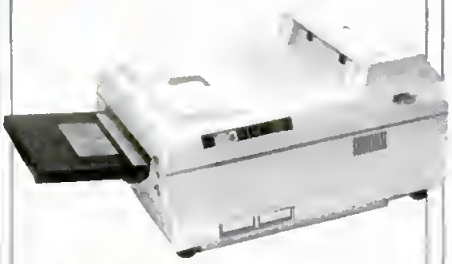
You can select either facedown or faceup paper delivery by moving a flimsy plastic latch under a small lid on the top of the printer. Opening this lid while the printer is on-line causes the printer to give a Cover Open message and go off-line. When the lid is closed again, you must wait 5 to 15 seconds for the Ready indication, which is a somewhat annoying arrangement. The Jet-Setter's speed is not improved by selecting faceup paper delivery, because diversion of the paper happens on top of the printer just before the paper would be turned over, not at the printer's side as it finishes printing.

The printer comes with 10-point Courier, Courier Bold, and 8-point Line Printer only, although you can get C. Itoh font cartridges ($149 to $199) that correspond to those available from HP. This is a nice touch, since it allows you to set up software for use with the HP cartridges, knowing that the same selection of fonts will be available from the corresponding C. Itoh cartridge. There are two font cartridge slots. The printer can also emulate an Epson FX-86E dot matrix or a Diablo 630 daisy wheel printer using a $159 ROM cartridge that fits into one of the font cartridge slots.

The print quality, while excellent in the end, took some playing around with to achieve. C. Itoh suspected at different times that the culprits could be the amount of toner in the machine, the humidity, and the quality of the paper that I was using. When all the above were optimized, the print quality was excellent, yet I cannot help wondering why the Jet-Setter seemed to be more sensitive than most to normal office inconsistencies.

With the Jet-Setter, C. Itoh has deliv-

PC MAGAZINE FACT FILE



C. Itoh Jet-Setter
C. Itoh Digital Products Inc.
19300 S. Hamilton Ave., #110
P.O. Box 9085
Torrance, CA 90508
(800) 423-0300
(213) 327-2110
List Price: $1,795
Dimensions (HWD): 11 × 21 × 16.6 in.
Weight: 66 lbs.
In Short: Using a Konica engine clocked at 4.9 ppm, the Jet-Setter is a low-cost, low-performance entry with 512K of RAM. The HP LaserJet Plus emulation and excellent print quality must be weighed against the machine's poor speed, high noise level, and large size.

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ered a low-cost, low-performance machine. While the HP emulation is good and the print quality can be excellent, the JetSetter's slow speed, high noise, and large size add up to a printer that's hard to like.
—Philip F. H. Rose

Cordata Technologies' $2,695 Cordata LP300X is an iconoclast, with a different way of doing almost everything. Rather than connecting through your PC's parallel or serial port, the Canon-engine laser printer comes with its own interface board and cable. Rather than handling control codes within the printer, it gives you the necessary software on disk in a memory-resident program. And rather than storing fonts in internal ROM, on font cartridges, or in RAM after downloading from your PC, the printer demands that you store them on disk.

Not surprisingly, installing the Cordata LP300X is different, too. You have to plug the interface board into a slot in your PC and run an installation program.

The installation program sets up your PC for the printer and configures the printer software for your system. After asking which printer port to use and how much memory to allot to fonts, the program adds a new line to both your CONFIG.SYS file (to load the printer device driver) and your AUTOEXEC.BAT file (to start the printer's memory-resident program each time you boot up). The default memory size for the printer program is 100K. The permissible range is from 32K to 512K.

The setup program also copies the printer driver and utilities to your hard disk and then asks you to insert the font disks one by one (all six of them). The total disk space that the fonts and the printer program require is nearly 2 megabytes.

With a little luck, your favorite programs will include a driver for the Cordata LP300X or the Cordata LP300. (The LP300X is upwardly compatible with the LP300, which we reviewed in last year's printer issue.) If not, you can try Cordata's Epson emulation.

Unfortunately, the Epson emulation is less than perfect. The manual warns against trying to use more than one character feature (such as emphasized and expanded) at a time. For a laser printer, each feature is a different font, and the Cordata LP300X can handle only one font change at a time.

If all else fails, you can always try creating your own printer driver using the Cordata LP300X commands. The commands consist almost entirely of easy-to-remember, English-like words.

THE CIRCLE AND THE EGG Printing graphics with the Cordata LP300X is somewhat easier than printing text, because the printer can handle either Cordata LP300X graphics or Epson graphics without special setup. But the manual warns that "distortion will occur with graphic images" in Epson emulation. Indeed, the circle the Cordata LP300X printed in PC Labs' test of Epson mode looks more like an egg.

The PC Labs graphics test turned up another problem in Epson graphics emulation. The printer put the header for page 2 in the middle of page 1, and it printed the graphics from both pages 2 and 3 on the second page.

On the PC Labs speed test, the Cordata LP300X managed a slow 4.1 pages per minute. Print quality is typical good laser quality. Graphics are sharp enough to retain detail in intricate patterns, but solid black areas are washed out.

The drawbacks to the Cordata LP300X's design are clear. Not only does the printer co-opt a slot in your PC along with a healthy chunk of memory, but because it uses an unusual connector, you can't plug it into a hardware printer buffer. (Although the Cordata LP300 also had trouble working with a background print spooler, Cordata has partly solved that problem in the Cordata LP300X.)

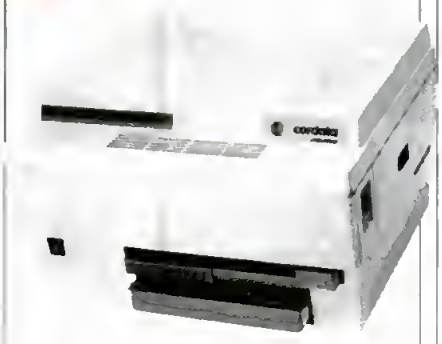
The combination of greater memory on the interface board (1.25 megabytes) and more efficient use of DOS calls in the printer's software makes background printing far more tolerable. The printer still hangs up your system for a second or two, but it no longer takes over for 5 seconds or more.

One of the good features of the Cordata LP300 was the way it handled bit-mapped graphics images, providing a simple route to a graphics screen dump. The Cordata LP300X improves on that feature. Any software that stores a bit-mapped image in your PC's memory can send that image to the printer with a single command sequence. The command specifies the memory address of the image, the size of the image, and where it should go on the page. In addition, Cordata has added new commands to speed up the graphics dump.

The Cordata LP300X also offers an improved ability to coexist with other boards and memory-resident programs. In previous incarnations, the printer's memory address was fixed. Now you can redefine it for any of three settings.

The printer's 110 fonts offer significant flexibility, but their sheer number can be overwhelming. It's easier to keep track of them as font families, numbering six monospaced families and seven proportionally spaced families. Curiously, the fonts avoid the standard 10, 12, and 15 pitch. Instead, they offer 9.375, 12.5, and 18.75 pitch. And only one font family of-

FACT FILE

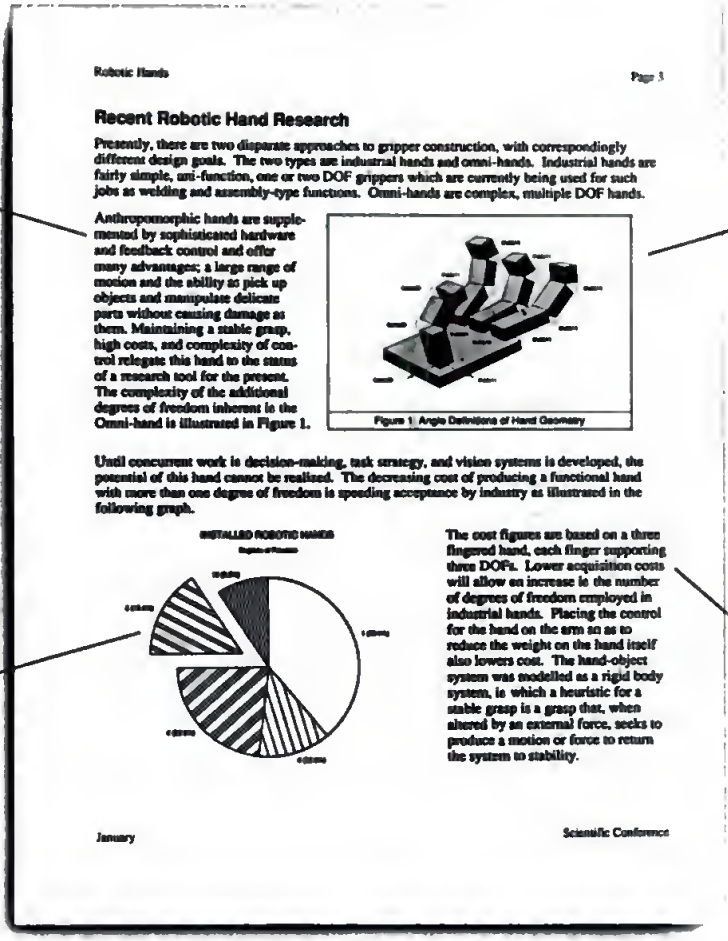


Cordata LP300X
Cordata Technologies Inc.
2001 Corporate Center Dr.
Newbury Park, CA 91320
(805) 375-1500
List Price: $2,695
Dimensions (HWD): 11.5 × 29 × 18 in.
Weight: 55 lbs.
In Short: This 4.1-ppm Canon-engine laser printer's unusual design requires an interface board in your PC, and it uses RAM to run a memory-resident program; its good points are the 110 built-in fonts and its ability to print bit-mapped graphics images.
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Robotic Hands

Page 3

Recent Robotic Hand Research

Presently, there are two disparate approaches to gripper construction, with correspondingly different design goals. The two types are industrial hands and omni-hands. Industrial hands are fairly simple, uni-function, one or two DOF grippers which are currently being used for such jobs as welding and assembly-type functions. Omni-hands are complex, multiple DOF hands.

Anthropomorphic hands are supplemented by sophisticated hardware and feedback control and offer many advantages; a large range of motion and the ability to pick up objects and manipulate delicate parts without causing damage to them. Maintaining a stable grasp, high costs, and complexity of control relegate this hand to the status of a research tool for the present. The complexity of the additional degrees of freedom inherent in the Omni-hand is illustrated in Figure 1.

Figure 1. Angle Definitions of Hand Geometry

Until concurrent work in decision-making, task strategy, and vision systems is developed, the potential of this hand cannot be realized. The decreasing cost of producing a functional hand with more than one degree of freedom is speeding acceptance by industry as illustrated in the following graph.

INSTALLED ROBOTIC HANDS

The cost figures are based on a three fingered hand, each finger supporting three DOFs. Lower acquisition costs will allow an increase in the number of degrees of freedom employed in industrial hands. Placing the control for the hand on the arm so as to reduce the weight on the hand itself also lowers cost. The hand-object system was modelled as a rigid body system, in which a heuristic for a stable grasp is a grasp that, when altered by an external force, seeks to produce a motion or force to return the system to stability.

January

Scientific Conference

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fers the IBM high-order character set.

The Cordata LP300X dares to be different, and its differences are both strengths and weaknesses. If you need the bit-mapped graphics dumps, or if you like the idea of having approximately 110 fonts available, give the unusual Cordata LP300X a trial run. Just be prepared to learn its language and tinker with your software's printer drivers.

—M. David Stone

Dataproducts LZR 1230

Most laser printers aim to make life easier for a user by printing jobs faster and more quietly than most other options. The $3,495 Dataproducts LZR 1230, from Dataproducts Corp., modestly sets its sights a bit higher: it aims to please three users at once.

To keep their costs down and their offices quiet, many users have tried to share a laser printer. This approach is reasonable, since a laser printer can more than keep up with just about any three typists you can find. But new problems and expenses emerged. Manual switches required careful coordination, and some laser printer manufacturers now warn against their use. There are intelligent printer switches, but they can cost $800 or more.

Dataproducts solves these problems by building a three-user interface into the 10.9-page-per-minute LZR 1230. It comes with one parallel and two serial ports, and, unlike some other printers that offer both parallel and serial ports, all three of the LZR 1230 ports can be hooked up to PCs at the same time. If a computer tries to send a print job while another is printing, the laser simply signals that it is busy. As soon as it has finished the first job, it will turn its attention to the second computer's work.

The combination of one parallel and two serial ports seems an excellent choice. The parallel port offers the advantages of simple configuration and quick setup. Each serial port can be configured to operate at a different baud rate, and other communications parameters can be set so that the printer can operate with different computers that use different settings.

Also helpful in a multiuser arrangement is the fact that the LZR 1230 emulates three printers that are industry standards. Not only does it accept the HP LaserJet Plus commands, but it can also be configured to respond to the Diablo 630 daisy wheel or Epson FX-80 dot matrix printer commands. That in itself isn't so remarkable, since many laser printers can imitate the same three. What sets the LZR 1230 apart from the field is that the emulation mode can be configured separately for each of the three ports—in effect, allowing different printers running software configured for different emulations to be linked to the same printer. We did not test this feature in the PC Labs tests, but the flexibility offered by this arrangement makes the LZR 1230 even more attractive as a shared printer.

SIMPLIFIED SETUP You might expect that all this flexibility would result in more complex setup procedures. Instead, the LZR 1230 offers a front control panel that simplifies matters greatly. It sports a 16-character LCD window and a 16-button membrane keypad. There is also a row of six status indicators that look like membrane buttons but are lit with small LED lights.

From the LZR 1230's keypad, you can set just about every feature the printer offers, from configuring the ports to selecting emulation modes, choosing fonts, and much more. The menus are complex, but a clear menu map that folds out from the back of the manual helps you keep your place in the different sequences. Once you have the settings the way you think you want them, you can print out a status sheet that lists most of the printer's setting parameters.

The manual also includes plenty of illustrations and is quite thorough. Where it gets somewhat skimpy is in the listing of the different emulation mode commands. Although the manual includes all the commands, it doesn't explain how to use them. For example, the HP font selection commands rely on a hierarchy of attributes, yet this is not explained.

The printer comes with five different fonts in both portrait and landscape mode. Only the Dutch 10-point font uses proportional type. The printer can also generate expanded and expanded-compressed fonts when running in Epson emulation; it can also boldface a font on the fly if a bold version of the type style is not available. It even has a special character-set option for its default Courier font that allows it to print high-order ASCII characters.

GRAPHICS The LZR 1230 produced mixed results in the PC Labs graphics tests. When in HP emulation, it performed extremely well. Black tones were sharp, grays evenly distributed, and the fine lines called for by the test were crisp and precise. It was one of the few printers I encountered that could perform as well as or better than the HP LaserJet Series II in terms of print quality.

On the other hand, the printer did not fare as well with the Epson FX-80 graphics test. Like a number of other lasers that emulate the Epson FX printers, the LZR 1230

FACT FILE



Dataproducts LZR 1230
Dataproducts Corp.
6200 Canoga Ave.
P.O. Box 746
Woodland Hills, CA 91365-0746
(818) 887-8000
List Price: $3,495
Dimensions (HWD): 18.9 × 19.4 × 12.6 in.
Weight: 85 lbs.
In Short: The 10.9-ppm LZR 1230 is a rugged, full-featured printer that is not priced competively with single-user printers, but offers some attractive potential for installations where two or three computers must share a single printer.

CIRCLE 547 ON READER SERVICE CARD

printed the test heading on one sheet, then ejected the page before printing the graphic. Again like many others, it worked much better with the MX-80 Graftrax emulation version of the test.

One other area of concern centers on the LZR 1230's method of arbitrating print requests. If the printer relies on a steady stream of data from a computer to determine that a job is not complete (such as when a database program must take time out to locate additional records), then some jobs could get inadvertantly scrambled. Another possible problem could occur when using programs that fail to recover "gracefully" from printer time-out errors, which are generated when the printer is tied up for a long time with another job. These problems can be overcome by overriding the automatic switching through the front-panel controls.

At 85 pounds, the LZR 1230 is far from svelte. But the sources of this extra weight are components that seem to be more substantial than those of much of the competition. The drum and developer units are more similar to those of mid-range desktop copiers than they are to the personal, portable copier technology used by many other laser printers. Dataproducts also offers a range of productivity-boosting accessories to supplement the two paper bins, such as a jogging offset paper stacker and an envelope feeder.

At $3,495, the LZR 1230 does not shine in the one computer-one laser printer market; there are better values. But when it's compared to the price of a competing product with a smart switching unit, the LZR 1230 picks up points. Add its solid construction, high-quality output, and useful options to the comparison, and the LZR 1230 becomes a printer worth looking at.—**Alfred Poor**

What looks like a laser printer, sounds like a laser printer, and produces high-quality results like a laser printer, but isn't a laser printer? The $2,495 CrystalPrint VIII from Data Technology Corp.

Sure, on the surface it's another 300-dot-per-inch page printer that emulates the Hewlett-Packard LaserJet Plus. But its veneer conceals a fundamental difference: the CrystalPrint VIII has no laser. Instead, it uses a strip of liquid crystal shutters (LCS) similar to the liquid crystals used in watch faces and portable computer displays, and its LCS print engine is built by Casio. Data Technology Corp. has obtained exclusive marketing rights to certain models of the Casio LCS engines and has added its own controllers to the mechanisms.

According to Data Technology, LCS technology offers some performance advantages over existing laser printer designs. The main point is that lasers must contend with possible distortion and difficulty in position control toward the outer edges of the scan line on the image drum. The LCS design uses individual shutters in precise locations, thus avoiding potential distortion. The imaging system in an LCS machine eliminates the rotating mirror found in a laser engine, reducing the number of moving parts.

FACT FILE



Data Technology CrystalPrint VIII
Data Technology Corp.
2551 Walsh Ave.
Santa Clara, CA 95051
(408) 727-8899
List Price: $2,495
Dimension (HWD): 13.5 × 18.3 × 16.5 in.
Weight: 70 lbs.
In Short: The 8-ppm CrystalPrint VIII has more memory and better speed than its competitors in this price range, while delivering excellent print quality. Its major weaknesses include the small number of resident fonts, paper-handling limitations, and unproven design.

CIRCLE 644 ON READER SERVICE CARD

MATCHES HP QUALITY Whether or not these design differences are significant is hard to evaluate. But it's nearly impossible to tell whether a given page was produced on a laser printer, such as the HP LaserJet Series II, or on a CrystalPrint VIII. On the HP emulation graphics test, the CrystalPrint produced results equal to those of the LaserJet Series II; toner distribution was perhaps slightly more even, and thin lines were perhaps slightly less crisp. Yet these differences are so fine as to be negligible. The CrystalPrint produces excellent-quality pages, and in the end, that's what really counts.

The printer also passed the other emulation tests with flying colors. The CrystalPrint correctly executed all LaserJet commands that it was given, and while its resident fonts do not provide high-order character compatibility with the PC character set, they do faithfully match the HP LaserJet Roman-8 symbol set.

The CrystalPrint is a bit weak on fonts. It comes with essentially the same selection as the original HP Laserjet Plus. You get 12-point Courier 10 pitch in both portrait and landscape orientations, plus an 8.4-point Lineprinter 16.6 pitch font in portrait orientation only.

The font limitations can be handled in two ways. The printer accepts two ROM cartridges for additional fonts, but these cartridges are not plug-compatible with those of the HP LaserJet; you can only use ones made by Data Technology. More to the point is that it accepts downloadable fonts in the HP LaserJet format. Unlike the original HP LaserJet or the new Series II, the CrystalPrint comes with 1.5 megabytes of RAM. This additional memory gives you much more flexibility in terms of being able to download fonts or print large areas of 300-dpi graphics.

The CrystalPrint VIII is rated at 8 pages per minute and was the only printer with this rating that I tested that managed to complete the PC Labs speed test with an 8-ppm result. This conservative estimate of the printer's specifications reflects well on Data Technology.

(continues)

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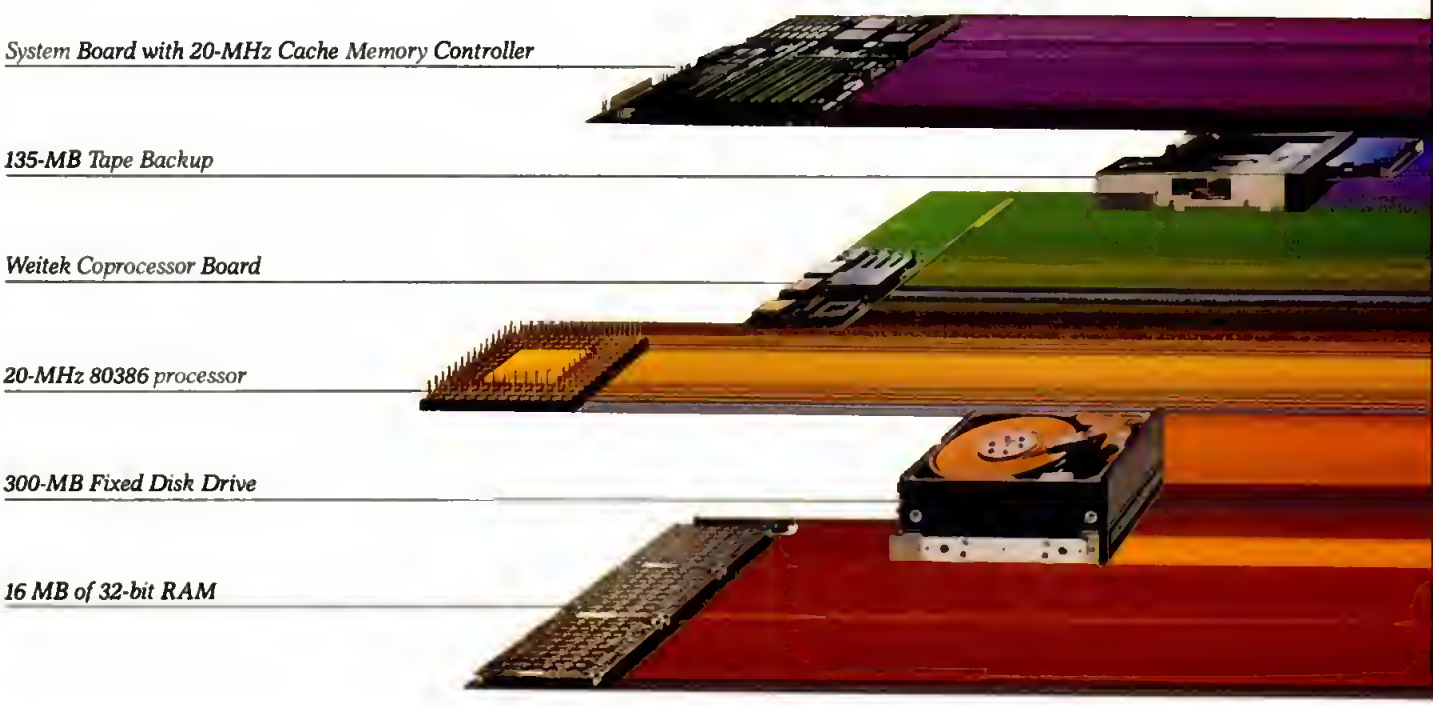
to run at its maximum speed. Together, they insure the highest system performance without sacrificing compatibility with industry-standard peripherals.

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erals operating at the industry-standard 8 MHz.

This flexible approach allows you to dramatically increase system throughput while preserving your investment in monitors, disk drives, and expansion boards. It can also accommodate today's and tomorrow's most advanced peripherals without constraining their performance.

Take options like our new Weitek™ Coprocessor Board. Never before offered in a PC, it can increase the speed of calculation-intensive, engineering and scientific applications by a factor of six, giving the COMPAQ DESKPRO 386/20 the performance of a dedicated engineering workstation at a fraction of the cost.

Compaq also provides 130- and 300-Megabyte Fixed Disk Drives with some of the industry's fastest access times. And when used with disk caching software, they represent the highest-performance storage subsystems available.

As for memory, Compaq offers 32-bit high-speed RAM. One full megabyte comes standard and is expandable to 16 megabytes without using an expansion slot. Plus, we included the COMPAQ Expanded Memory Manager. It supports the LIM standard so your software can break the 640-Kbyte barrier even before OS/2™ is released.

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Compaq has long been recognized as the world leader in both 80386 technology and portable computing. So it isn't surprising that we would combine the two.

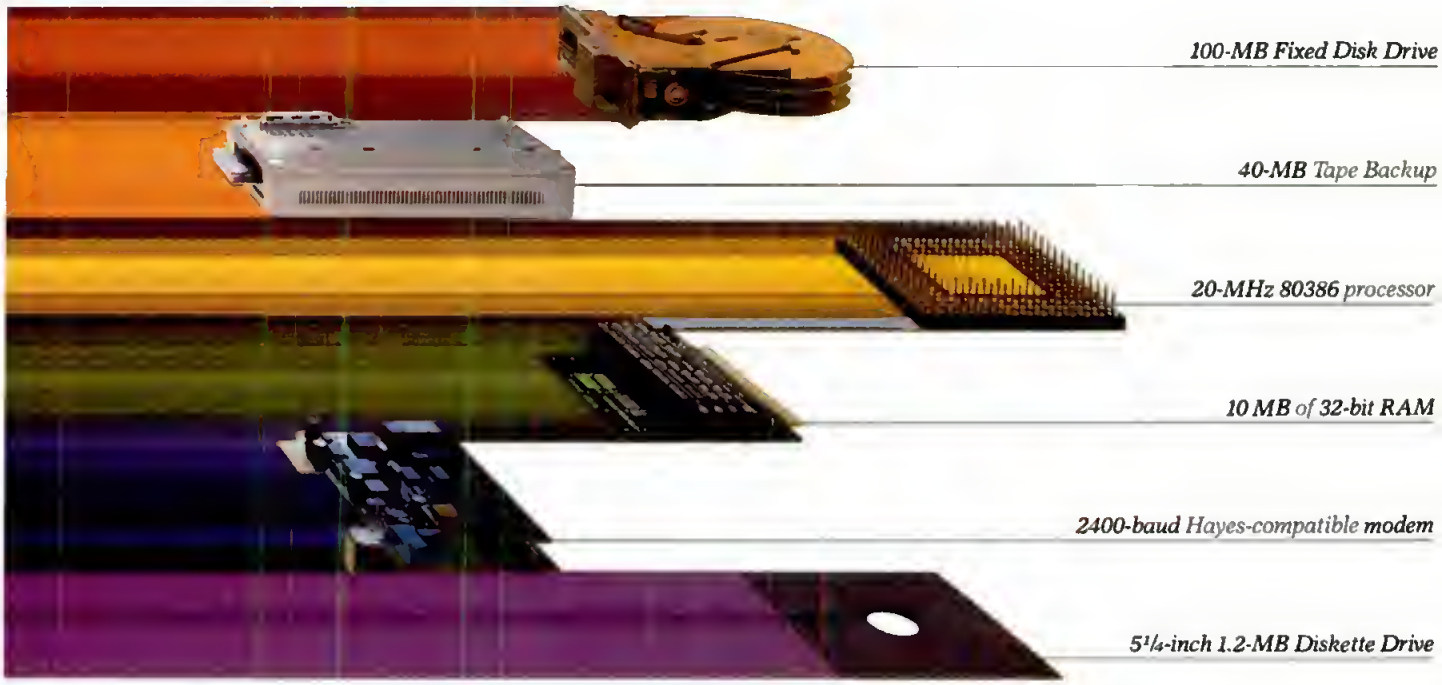
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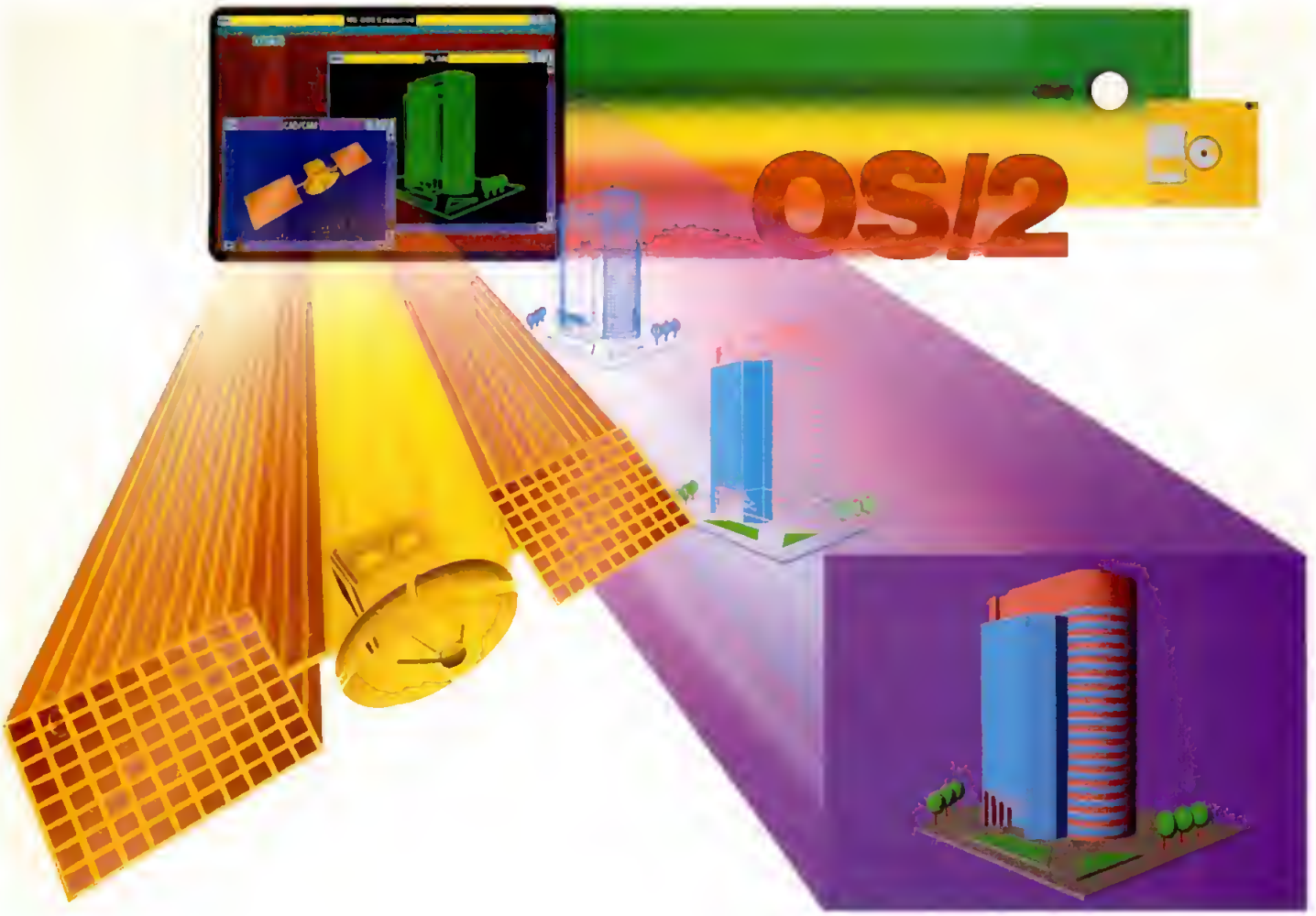
We've become famous for building desktop computer capabilities into our portables without leaving anything out. The COMPAQ PORTABLE 386 is more proof. It has a high-resolution, 640 × 400, 10-inch plasma display; a full-size, portable enhanced keyboard; two industry-standard expansion slots in a lightweight, optional plug-on unit; a choice between an optional 2400- or 1200-baud Hayes®-compatible modem; a full-size 5¼-inch 1.2-MB diskette drive; even an optional 40-MB tape backup.

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MANUAL UNAVAILABLE Although the CrystalPrint VIII is already in production, Data Technology was unable to provide one component of the package in time for evaluation: the manual. The printer arrived with supplies, a pamphlet from Casio that explains how to install the drum and toner, and nothing more.

The printer offers both parallel and serial ports and has a 250-sheet paper cassette. There is a manual feed option available at extra cost. The output is only face-up, and the dust cover of the paper cassette serves double duty as the output tray.

I was able to set up and run the printer with the help of the Casio documentation. And after fumbling with the front panel, I was able to produce a test print page that showed the status of the switch settings. The front panel can also be used to coax out a sample sheet listing all available fonts. The machine comes with a two-digit LED display on the front panel, along with seven indicator lights and six buttons. I assume from information provided by the vendor that these can be used to control the printer settings, but without documentation I was not able to test their functions.

Aside from those problems, I found the machine to be easy to set up and operate. Relying on prior knowledge of the HP LaserJet command set, I was able to get the printer to perform all the required tests. It was not able to create bold or italic fonts on the fly, but the existing fonts were clean and sharp.

> At a list price of $2,495, the CrystalPrint VIII is priced competitively with other new page printers.

The CrystalPrint VIII relies on a design that is relatively new and untested in the PC marketplace. At a list price of $2,495, it is priced competitively with other new page printers. It is short on fonts and front-panel information, yet it compensates with speed, print quality, and memory. It does not shut out its competitors, but it does offer a reasonable alternative to other similarly priced printers.—**Alfred Poor**

Destiny Laser Act 1

The $2,595 Destiny Laser Act 1, from Destiny Technology Corp., is one of many new contenders to step into a market dominated by the Hewlett-Packard LaserJet Series II. Based on the 6-page-per-minute Ricoh engine and having a measured speed of 5.8 ppm, it is about the same weight and size as the rest of those in its class. But as the new kid on the block from a new company, the Laser Act 1 will have a tough fight against the reigning 8-ppm champ—the HP LaserJet Series II—especially considering that the LaserJet Series II's street price is well below $2,000.

The Laser Act 1 has a standard Ricoh front panel through which you can enter form feeds, switch between portrait and landscape fonts, toggle between two fonts, and change paper size, all on the fly. You can insert and remove font cartridges simply by putting the printer off-line—unlike the HP LaserJet, which must be turned off. Setup was straightforward and took only about 10 minutes.

Changing between the standard Centronics parallel and RS-232C serial interfaces was another story, however. It involved unscrewing both the lid and a metal plate under the lid, which revealed a bank of DIP switches that were referred to in the manual but lacked a picture showing their location. Although you would only have to perform this operation rarely if at all, it is unnecessarily complicated and frustrating.

The Laser Act 1 passed our graphics and text-compatibility tests with its HP LaserJet Plus emulation, but it is not simply an HP LaserJet Plus clone. Destiny Technology Corp. has attempted to add value in the areas that matter most to the desktop publishing and CAD markets.

The standard Laser Act 1 package includes 1.5 megabytes of RAM and a disk of downloadable fonts. An interesting feature that Destiny has introduced is special handling of graphics images, which can be done in two ways. First, the vendor has added a special set of vector graphics commands that are accessible either through their own codes or through an extra-cost driver for *AutoCAD*. A brief set of instructions in the manual shows how to use the vector commands to create a form with line borders and the like. Then a page of text can be overlaid onto the form in a single pass, resulting in an original filled-out form.

The second and perhaps more significant way that Destiny has improved on the standard is in its special treatment of normal HP LaserJet Plus graphics. The biggest drawback of Ricoh-engine-based machines is their rated speed of 6 ppm, which is 2 ppm slower than that of Canon-engine-based machines. The results of our PC Labs speed test show that the difference between these two types of machines is typically about 1.5 ppm when printing a text document. But when it comes to printing graphics, anyone who has spent much time with laser printers knows that those ratings go out the proverbial window.

PC MAGAZINE FACT FILE



Destiny Laser Act 1
Destiny Technology Corp.
1012 Stewart Dr.
Sunnyvale, CA 94086
(408) 733-3171
List Price: $2,595
Dimensions (HWD): 16.45 × 16.06 × 8.07 in.
Weight: 37.5 lbs.
In Short: A logically designed Ricoh-based printer with a tested speed of 5.8 ppm and with such features as 1.5 Mbytes RAM, utility software, and a disk of downloadable fonts included, the Laser Act 1 offers good value for the money and is fast at printing graphics. But its unproven track record places it at a disadvantage in light of the HP LaserJet Series II's solid history of impressive performance.

CIRCLE 627 ON READER SERVICE CARD

Destiny has tweaked its graphics manipulation, resulting in a claimed speed that is 25 percent faster than the HP LaserJet Plus when printing graphics only. We informally checked out this claim in the PC Labs and found that the Laser Act I processed a 350K graphic image approximately 20 percent faster than an HP LaserJet Plus. Even when the slower printing and paper handling are factored in, the result is still a 15 percent improvement. Our tests also revealed that this boost is not typical of Ricoh-based machines.

Destiny ships a utility program with its printer that allows you to control many of the printer functions from your PC. These include the ability to select primary and secondary fonts from all available fonts in ROM, from an installed cartridge, or from among downloadable fonts. You can then select between the primary and secondary fonts on the fly from the front panel; alternatively, you can use the standard HP-compatible methods to select fonts, too. You can also reset the printer and do page setup operations, such as setting paper size, margins, and number of copies. But the program takes some time to get used to, forcing you to use the Arrow keys rather than the more traditional Return, Spacebar, and Esc keys to peruse your options and make selections. Once you get used to the program, though, it is tolerable and useful, especially if the printer is not sitting next to your desk.

The Laser Act I passed our graphics and text-compatibility tests with its HP LaserJet Plus emulation, but it is not simply an HP LaserJet Plus clone.

A reviewer who encounters a good product from a small company when big players are already in the market faces a dilemma. In this case, the Laser Act I's ability to print graphics 20 percent faster than does the HP LaserJet Plus speaks well for the machine and its manufacturer. But any determination of value must include such factors as a product's track record of durability and a vendor's history of providing support. Although these unknowns are offset somewhat by the Laser Act I's use of a standard print engine, the pluses on the side of the solid and impressive HP LaserJet Series II are likely to overwhelm this promising new contender.

—Philip F. H. Rose

Epson GQ-3500

The Epson GQ-3500 laser printer, from Epson America, is a Ricoh-engine-based machine with a few design features specific to this model. The GQ-3500 lets you make a simple adjustment to determine whether paper comes out faceup in reverse order or facedown in collated order. The Epson LQ-1500 printer emulation is very good, and the printer can emulate other printers as well. Fonts can be conveniently added with credit-card-sized modules. If you're in the market for an entry-level laser printer, the $2,199 GQ-3500 is one to consider.

The GQ-3500 is rated at 6 pages per minute, but like most printers it fell a bit short of the rating in our tests. In the PC Labs 20-page laser speed test, the GQ-3500 registered a speed of 5.4 ppm.

Laser print quality is supposed to look at least as good as a duplicate of a typed original produced by a good copier. The GQ-3500 measures up to copier-quality level, but it doesn't stand out above other 300-dot-per-inch laser printers. Our graphics emulation test in the standard Epson LQ-1500 mode produced output that looked like a good copy of graphics printed by a dot matrix printer, complete with jagged edges on curved lines. The optional HP LaserJet emulation cartridge, however, ran the same test in HP mode with much-improved resolution and smooth lines.

Standard fonts include 10-pitch Epson Courier, Modern Proportional Space, 13-pitch EDP, and an Extended Graphics font. All of the fonts print in both portrait and landscape modes except the Proportional font, which works only in portrait mode. The proportional font is listed in the printer specifications as a 12-character-per-inch font; this is an approximate measure since proportional spacing by definition varies the number of characters printed per inch according to the width of each character.

Additional fonts come on small, credit-card-sized cards. Two cards can be inserted in the machine at once, and they cost $149.95 apiece. Cards currently available include Gothic Normal, Helvetica Normal, Times Roman, Helvetica Proportional, Times Roman Landscape, and Helvetica Normal 18 and 24 fonts. There are also two emulation cards that can make the Epson GQ-3500 act like a Hewlett-Packard LaserJet or a Diablo 630 daisy wheel printer. These cards cost $169.95 each. You can also download fonts in the GQ-3500's standard 640K memory. Laser printers are supposed to be quiet, and the GQ-3500 meets those expectations with a sibilant 60 decibels on our sound meter.

Installation of the separate toner and developer units takes just a few minutes, and you have to be reasonably careful not to spill the toner. However, its size presents

PC MAGAZINE FACT FILE



Epson GQ-3500
Epson America Inc.
23610 Telo Ave.
Torrance, CA 90505
(800) 421-5426
List Price: $2,199
Dimensions (HWD): 8.5 × 32.4 × 16 in.
Weight: 36 lbs.
In Short: Epson's GQ-3500 is a fine-performing Ricoh-engine-based laser printer. Clocked at 5.4 ppm, it features Epson LQ-1500 emulation, dual paper-output methods, and easy-to-use font and printer emulation cards.

CIRCLE 619 ON READER SERVICE CARD

another problem: the GQ-3500 is not terribly big itself, but the manufacturer recommends that you leave 40 inches in front of the printer, 15 inches on the right, 4 inches on the left, and 12 inches behind it for working and ventilation space.

The documentation for the GQ-3500 is not up to Epson's usual high standards. There is not enough information on downloading fonts, and the index is too sparse. But there are good appendixes, and the installation information is helpful.

The GQ-3500 emulates the Epson LQ series of 24-pin printers and also has modes for page printer and line printer identities.

One particularly nice feature on this printer is the complete control panel. You can use this panel to set paper size, number of copies, print orientation, font, pitch, and language.

The control panel menu works only when the Epson GQ-3500 is used with its own identity; with the HP LaserJet emulation cartridge, all page and print feature controls must be set by software.

The Epson GQ-3500 is a competent laser printer with user-friendly paper- and print-control features. Its ability to use font and printer-emulation cards increases its flexibility, but if you need too many extras the GQ-3500's slight price advantage over other laser printers is lost.—**Bruce Brown**

Genicom's Centronics PagePrinter 8

Genicom's Centronics PagePrinter 8 ($3,045, including HP emulation) has more in common with old photocopying machines than it does with modern laser printers, especially when it comes to installing toner and developer and setting up the machine. A Sharp-engine printer, the PagePrinter 8 offers one of two installable emulation cards (for Epson/IBM/Diablo mode or for HP LaserJet Plus mode), a speed of 4.9 to 7.5 pages per minute, and optional font cards. While the quality of its print and the emulations are respectable, you'll question whether the output is worth the expenditure of time, effort, and space.

Installing the printer is a lot like city gardening: you'll get dirty, you'll find your original site smaller than your needs, and you'll require a lot of patience, but you'll reap the fruits of your labors—eventually.

The PagePrinter 8 seems to excel in discovering ways to redecorate your person, your clothing, and itself with fine grains of dark toner. What's worse, installing it entails assembling seven major components: developer housing, developer cartridge, toner cartridge, photoconducter belt, oversized paper tray, interface/emulation board, and memory board.

The actual process begins when you slide the developer housing into the printer. You then remove the metal foil strip from the bottom of the developer cartridge, turn the cartridge upside down, slide it over the housing, and remove the stopper. Finally, you can turn the printer on and have it mix whatever developer hasn't spilled. (The resulting sound is like a trash compactor crushing your best china. Fortunately, the clanging continues only for the duration of the mixing process.)

After turning the printer off, you can install the toner. Once again, you must insert the cartridge upside down. (On the plus side, all unused toner is recycled, so you won't have to replace the cartridge as often as with some other printers.) You then install the corona wire, fuser pad, and photoconductor belt. Although the extremely thin, fragile, elliptical photoconductor belt comes on styrofoam flanges to ease its installation, you will inevitably have to reshape it to slide it over the two drums.

INTEGRATED BOARDS Unlike most laser printers, which have their emulations directly on the laser's controller card, the PagePrinter 8 uses 6-inch boards that integrate the emulation and the interface. The boards slide into an easily accessible compartment in the rear of the printer. Although this design means you pay for only the emulation and the interface you need (from $200 to $250), it also requires you to swap boards every time you want to change emulation or interface. Ideally, you'd use only LaserJet emulation, but it prints one-third slower.

The printer we tested used a parallel interface, but RS-232C serial and IEEE 488 interfaces are also available. An optional 1.5-megabyte memory board ($250) fits into a compartment alongside the interface/emulation board. While the additional memory is helpful with the Epson/IBM/Diablo emulation mode, it is virtually a requirement for the HP LaserJet Plus emulation mode.

Like the cassettes found in early copy machines, the PagePrinter 8's paper tray is huge. Once it and the output tray are in place, the printer takes up over 3 feet of space. If you place it on your desktop with an AT, you'll be lucky to have enough room for even a coffee cup.

The PagePrinter 8 comes with only two built-in typefaces: Courier 10 and Line Printer. But, unlike those in the HP LaserJet, the bold and italic enhancements are built in, and you can also set the pitch for 5 and 16.6 characters per inch. Optional cartridges provide additional fonts for the Diablo 630, Diablo 630E, IBM PC Printer, IBM Proprinter, and Epson FX-80 emulations.

The PC Labs speed test showed a discrepancy in throughput between the two emulation modes. While the Ep-

PC MAGAZINE FACT FILE



Genicom Centronics PagePrinter 8
Genicom Corp.
Genicom Dr.
Waynesboro, VA 22980
(800) 437-7468
List Price: $2,495; with HP emulation, $3,045.
Dimensions (HWD): 11.5 × 17.1 × 17.7 in.
Weight: 66 lbs.
In Short: This laser printer, based on a Sharp engine, gives you a speed of 7.5 ppm in Epson/IBM/Diablo mode and 4.9 ppm in HP LaserJet Plus mode, but setting it up requires more effort than the output may be worth.

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If you're looking for a high-speed laser printer that can easily handle as many as 25,000 pages a month, the new Toshiba PageLaser12® is the machine for you.

It thrives in any high-volume office environment. Whether it consists of a productive single user, or a network of multiple users sharing the workload.

PageLaser12's extended product life might help to explain its hard-work mentality. At up to 1.2 million pages, it's three times more durable than other laser printers.

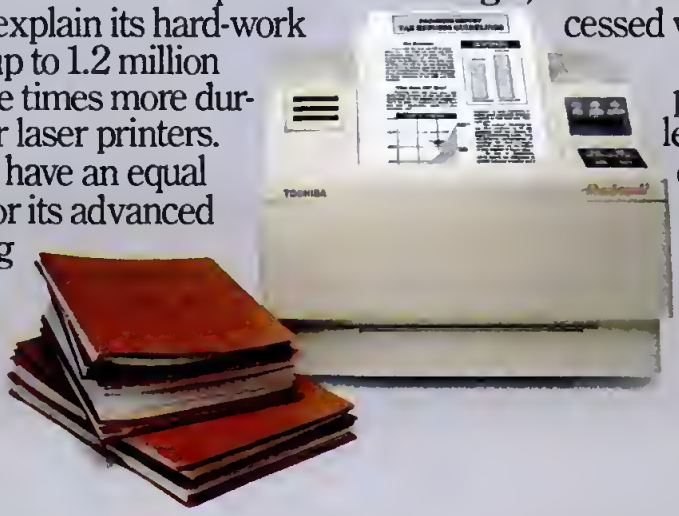
You'll also have an equal appreciation for its advanced paper handling options. Our Toshiba-made dual-bin paper feeders, combined with PageLaser12's standard cassette feeder, give you a paper capacity of 750 sheets.

That's 500 sheets more than most other laser printers.

But here's the best part. With three paper feeders, you can now print multiple paper types and sizes automatically. Letter, legal, letterhead, even labels can be accessed with no physical change.

What's more, our optional proprietary envelope feeder lets you print large quantities of envelopes without constantly banging away on your office typewriter.

You can also use the same font style that appears on your letters to create a



For The PageLaser12.

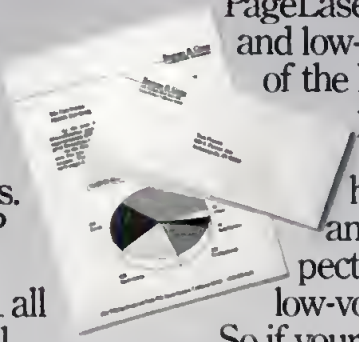


more professional, unified look.

But don't think for a second all these bells and whistles slow down performance. At 12 pages per minute, PageLaser12 is up to 50% faster than many other laser printers.

As for multiple emulations, HP LaserJet 500 Plus,® Diablo,® IBM® Graphics, Qume® and Toshiba P351 all come standard, as do parallel/serial interfaces. There's also a 1.5MB memory option for full-page 300 dpi graphics. And our optional output jogger/collator ensures easy separation of multiple copy output. All of which means PageLaser12 can meet the needs of any office worker.

A complete library of Toshiba font cartridges is available with multiple HP LaserJet-compatible fonts on each cartridge. And



PageLaser12's high-volume capability and low-priced supplies produce one of the lowest desktop laser costs per page in existence.

To top it off, you get all this high-volume ingenuity, speed and flexibility for what you'd expect to pay for a less equipped low-volume laser printer.

So if your business prospers on high volume, get the laser printer that does the same. The PageLaser12.

For more details, call 1-800-457-7777 for the name of the Toshiba printer and computer dealer nearest you.

Then see how well PageLaser12 performs in your surroundings.

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Toshiba America, Inc., Information Systems Division

son/IBM/Diablo interface card produced 7.5 ppm, the throughput was a miserly 4.9 ppm in HP LaserJet Plus emulation. The drop in performance can be explained by the fact that the printer performs the HP LaserJet Plus emulation in full-page bit-mapped graphics. Unfortunately, no DIP switch or software support sets the emulation to half-page graphics. As a result, you'll get excellent graphics from the HP LaserJet Plus emulation but poor speed.

The Epson/IBM/Diablo mode has some drawbacks too. The only way to switch emulations is by resetting the DIP switches. As a result, if your applications require different printers, you will not be able to swap emulations as easily as with other printers.

The Genicom Centronics PagePrinter 8 is not what you'd call state of the art. It asks too much from you during installation and doesn't provide enough flexibility in emulation management. Although its print quality and speed are respectable, so are those of some of the smaller, easier-to-set-up laser printers we reviewed.

—Vincent Puglia

Genicom 5010

Weighing in at 94 pounds, Genicom's $3,495 laser printer, the Genicom 5010, is about the size of a small refrigerator, requiring that it be delivered on its own shipping pallet. Its ribbed top, ten front-panel switches, eight status lights, alphanumeric LCD display, and slots for four font cartridges reinforce the message sent by its rugged-looking case and its bulk: this printer really means business.

Setting up the Genicom 5010 requires more steps than do most laser printers. To begin with, you have to install its Hitachi engine's drum, toner, and developer separately.

The drum slides in on the left side, where a rod holds it in place, like shish kebab on a skewer. Toner and developer go under the lift-off top cover. We suspect that you can quickly learn to install the developer, but on our first try, it spilled all over the top of the printer. Fortunately, the rest of the setup procedure is straightforward.

You'll also need to install a personality module, in the form of a 7- by 9-inch board, one of which comes with your printer. You slide it into the slot in back of the printer, much as you'd insert a card in your PC. The personality module supplies both command logic to the printer and connectors to attach the cable.

The two personality modules available include one for HP LaserJet Plus emulation and one for Diablo 630 or IBM Graphics Printer emulation, with the best choice being the HP emulation. Each module has DIP switches to set the printer defaults and choose between the parallel and the serial connector.

The Genicom 5010's reliance on personality modules means that it's pretty much limited to emulating either the HP LaserJet Plus or the Diablo 630 and the IBM Graphics Printer, but not all of them. Although you could buy both modules, changing them is equivalent to changing boards in a PC.

Even the combination Diablo 630 and IBM Graphics Printer module discourages jumping between the two emulations. The only way to do so is by resetting a DIP switch, and that also means turning off the printer and removing the module's card. Clearly, if you want to use more than one printer emulation, the Genicom 5010 is not the best choice.

The printer's front-panel controls include buttons to change orientation, select character spacing, and choose line spacing. There's also a button to switch between the standard paper tray and the optional second paper tray. These push-button controls are generally easier to use than the equivalent software commands.

Once you've set it up, the Genicom 5010 takes up less space than some smaller printers. This apparent paradox is the result of good design. Everything you need to get at regularly—input tray, manual feed tray, font cartridge slots, and control panel—is in the front of the printer. The output tray is a depression in the printer's top, where the paper falls face forward to collate automatically.

The Genicom 5010's heavy-duty design pays off. The printer can handle up to 5,000 copies per month. And speed and print quality are both impressive. Rated at 10 pages per minute, the Genicom 5010 scored a hefty 8.5 ppm on the PC Labs speed test. Text print quality is among the best for laser printers.

On the PC Labs graphics test the Genicom 5010 managed both the IBM Proprinter and the HP LaserJet Plus emulations without problems. The graphics that the Genicom 5010 produced in Proprinter emulation were among the best, even though the manufacturer says the printer is compatible with the IBM Graphics Printer and not fully compatible with the Proprinter. Solid areas come out solid and black. Intricate patterns retain all their detail. Graphics quality with HP LaserJet Plus emulation is one notch lower, with the printer losing some thin lines.

Built-in rotatable fonts on the Genicom 5010 are limited to Courier (10 pitch), Prestige Elite (12 pitch), and Gothic (17 pitch). Three of the 23 available font cartridges are for the IBM Graphics Printer and Diablo 630 emulations. The rest will

PC MAGAZINE FACT FILE



Genicom 5010
Genicom Corp.
Genicom Dr.
Waynesboro, VA 22980
(800) 437-7468
(703) 949-1170
List Price: With IBM Graphics Printer and Diablo 630 emulation, $3,495; with HP LaserJet Plus emulation, $3,695.
Dimensions (HWD): 15 × 17.7 × 19.6 in.
Weight: 94 lbs.
In Short: This heavy-duty laser printer, built on the Hitachi engine, offers 8.5-ppm print speed, superior print quality, and rotatable fonts; its reliance on personality modules means that you can use it effectively only for either the IBM/Diablo or the HP emulation.

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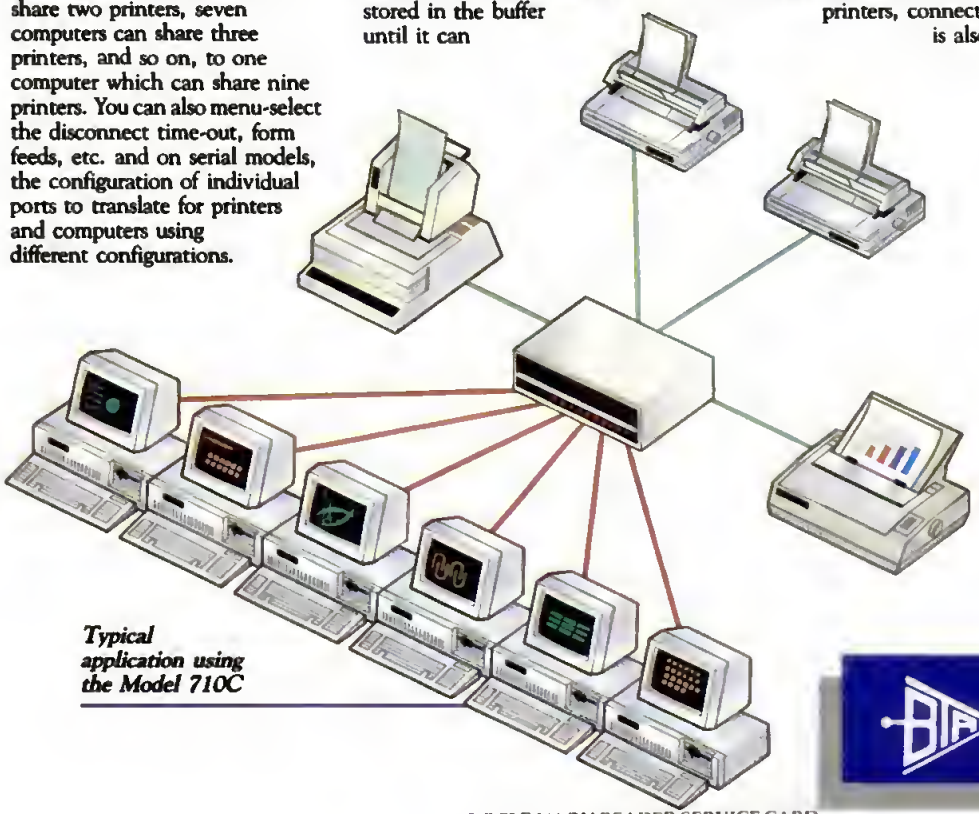
You configure Print Master's ports for any combination of printers and computers by answering questions from easy-to-follow menus. For example, with the ten pott Print Master, nine computers can share one printer, eight computers can share two printers, seven computers can share three printers, and so on, to one computer which can share nine printers. You can also menu-select the disconnect time-out, form feeds, etc. and on serial models, the configuration of individual ports to translate for printers and computers using different configurations.

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If several users are sharing one printer, printer sharing via Print Master is completely automatic. There are no codes to send. You simply perform your normal print operation. If you are sharing several identical printers, connection is also automatic. Again, you perform your normal print operation and are connected to the next available printer on a first-come-first-serve basis. Print Master will send data to all printers simultaneously to keep your printers running at full capacity.

If you are sharing several different printers, such as a laser-jet, a dot matrix and a plotter, and you wish to select a specific printer, you do your normal print routine and also send a printer select code (which you can define yourself) before the first characters of your data. The data is then routed to the selected printer. It's that easy.



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706E (4 serial/2 parallel), $795
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800-523-2702

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work only with the HP LaserJet Plus emulation. Also, in HP mode the printer can download any HP-format soft font sold by third-party vendors.

The one drawback to the Genicom 5010 is its price. But this printer is for those who need a laser printer that is more rugged than versatile and who value speed and stamina over low cost. If you must have high-quality output, 8.5-ppm speed, and up to 5,000 copies per month—and if you're willing to choose one emulation mode and stick with it, at least for a while—you'll want to have enough money in your budget to cover a heavy-duty printer like the Genicom 5010.

—M. David Stone

Hewlett-Packard LaserJet Series II

How do you stay number one in a competitive market? It's not easy, but Hewlett-Packard Co.'s LaserJet Series II printer seems to put the competition to bed with its unbeatable combination of price, features, and power.

Almost every segment of the microcomputer market has a trendsetter. IBM did it with the PC, Hayes with the Smartmodem, Lotus with *1-2-3*, and Ashton-Tate with *dBASE III*. In the world of desktop laser printers, Hewlett-Packard set the standard with the original HP LaserJet.

Other products compete with these standards by isolating and improving on a single feature of the original—typically, price. But you won't find yourself struggling to choose between the original and its competitors this time. When HP upgraded its successful LaserJet and unveiled the new Series II, it not only added features and shrank the printer's size, but it also slashed the price of the new machine by about 40 percent compared with that of the LaserJet Plus it replaced. At a list price of $2,595 (recently raised $100), the LaserJet Series II can compete on price with almost any other laser printer on the market.

The LaserJet Series II doesn't skimp on value for those dollars, either. It supports the entire HP LaserJet Plus command set and accepts HP format downloadable fonts. It includes the same half megabyte of memory that the LaserJet Plus offered. It comes with a parallel and a serial interface and can be fed paper either automatically by a paper cassette by hand or a sheet at a time. It even accepts the same ROM font cartridges used by the earlier LaserJet models.

HP engineers further improved the printer by using a new laser print engine, the Canon SX. Rated at the same 8 pages per minute as the venerable Canon LPB-CX engine (which drove the original LaserJet, the Apple LaserWriter, and the QMS Big Kiss), the new one is only two-thirds the size and weight of its larger, older sibling. The result is a lower, sleeker housing that takes up less space and is easier to move when necessary. And the new engine performs at a measured speed of 7.5 ppm, quite close to its rating.

The new engine keeps the same design for the drum and the toner: both are combined into a single, disposable cartridge. Other printers offer separate drum and toner units, but these typically result in more difficult maintenance and little if any per-page savings.

One disadvantage to the smaller engine, however, is that it cannot use the older machine's drum cartridges, and the new ones cost a bit more (list price, $115), although you get about 25 percent more pages per cartridge with the new design. On the other hand, the tendency of the original LaserJet to print unevenly when printing large areas of black is a thing of the past. The new Series II engine prints a solid, dark black, even over large areas. The difference is striking.

FONTS The HP LaserJet Series II also comes with a few more fonts than its predecessors. Besides the familiar 10-pitch Courier in portrait and landscape modes, the Series II also offers the tiny 16.6-pitch Line Printer font and a 10 pitch Courier Bold in both portrait and landscape orientations. These six fonts are twice as many as are offered in the HP LaserJet Plus, but still far fewer than the number offered by many competitors.

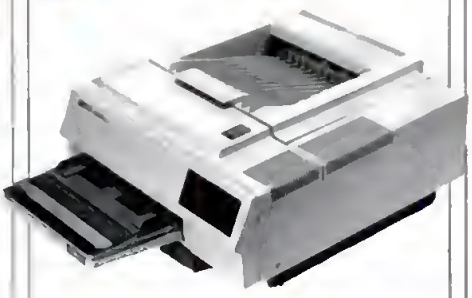
You can solve the font shortage in one of two ways. The machine will accept two ROM font cartridges at one time, so you can have more than a dozen fonts instantly available. A more economical solution is the use of downloadable fonts, available from HP as well as from third-party sources, although this approach requires more time and takes up some of the printer's available memory.

You need not run out of memory, however, should you want to download lots of fonts or print large graphics in full 300-dot-per-inch resolution. HP makes it easy and fairly affordable to expand the printer's half megabyte of memory by adding expansion boards that boost it by an additional 4 megabytes of RAM. With a total of 4.5 megabytes, there will be plenty of room for both fonts and graphics.

Another major improvement over the original design is prominently displayed on the new printer's front control panel. No longer must users contend with the cryptic two-character messages from the LaserJet of the past. The Series II includes a 16-character LCD panel that gives the familiar numeric messages along with prompts in English that spell out their meaning. (Not all the messages are helpful

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Hewlett-Packard LaserJet Series II
Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
(800) 752-0900
List Price: $2,595
Dimensions (HWD): 18 × 27 × 8.5 in.
Weight: 50 lbs.
In Short: Still the one to beat, the 7.5-ppm HP LaserJet Series II builds on the past success of the LaserJet Plus, adding a few more fonts, dropping important pounds and inches from its dimensions and dollars from its price, and delivering solid black images as well as or better than those of most of its competition.

CIRCLE 546 ON READER SERVICE CARD

since more than one simply shows the word "ERROR" or "SERVICE." But since the numeric codes still correspond to the original LaserJet error codes, you can decipher them by referring to a manual for the older machines.)

The front panel not only conveys more information, but it also eliminates the dreaded DIP switch. Want to change interface or bps rate? Need to select a different font but can't get at the commands through your software? Want to change margin settings, paper source, or number of copies? With the original, these tasks required either excavating the DIP switches buried within the case or sending a complex command sequence, or both. Now you can perform all these jobs simply by pressing the buttons on the control panel. The options and the display are not as extensive as some of the other lasers that have appeared since the Series II, but the facilities should be more than adequate for most users.

REVISED MANUALS The manuals have also been revised for the Series II, with both some improvements and some ground lost. Like the latest versions of the original LaserJet, the Series II comes with a pair of manuals, but the organization is a bit different. The first manual for the Series II is devoted to installation and includes excellent illustrations that make good yet sparing use of color to show exactly how to unpack and set up the printer. The first section takes you through running the printer's self-test and printing a sample status page. The second half of the manual covers detailed instructions on configuring the printer to run with any one of ten different popular computers, from the Apple IIc to the IBM AT. Generic instructions are also included.

The other manual is the user manual, it contains instructions on programming via the front panel and the LaserJet software control commands. It also includes tips on using the Series II with a range of popular MS-DOS applications programs. Like the original LaserJet reference manual, the new user manual includes a table that lists all the different software control commands. Unlike the original, the manual explains fewer than a third of the available commands, referring you instead to an optional book called *LaserJet Series II Technical Reference Manual*. This is unfortunate; one of my big quarrels with some of the LaserJet clones is that they do not adequately explain the command set and refer you to HP documentation. Here HP does the same thing. Users don't read manuals any more than they have to, so including full details about the command set shouldn't scare anyone off. The information should be there for those who need it.

The printer shows some other important improvements. The paper cassette has been enlarged to hold 200 sheets of standard weight paper. You can also get your output in facedown, collated order. Unlike some competing designs, however, the facedown feature was not made at the expense of a straight-through paper path for heavier stock such as transparencies; pull on a hatch and you get the same faceup output as on the original LaserJet.

Something old and something new, the Series II shows clearly that HP is able to stay in front of the pack by offering a competitively priced product that builds on the successful features of the past models without losing compatibility. The LaserJet Series II remains the standard against which other laser printers must be judged.
—Alfred Poor

Kyocera F-1010

On paper, at least, the Kyocera F-1010 is an exciting printer. For $3,695, you get a list of features hard to find at twice the price.

The F-1010, from Kyocera Unison, is rated at 10 pages per minute; the PC Labs speed test clocked it at a brisk 9.2 ppm. The list of six emulated printers includes output heavyweights such as the HP LaserJet Plus, Epson FX-80, and IBM Graphics Printer—printers any software package worth its salt should accommodate.

To top it all off, the F-1010 packs 36 resident fonts based on six typefaces, including Courier, Times Roman, Letter Gothic, and Helvetica. You can also download additional HP LaserJet or Kyocera fonts or generate your own with Kyocera's Prescribe command language.

But the excitement fades a bit once you get past the initial status sheet.

The F-1010 depends heavily on its emulations, always operating under one of the six it offers. The HP LaserJet Plus emulation passed the PC Labs emulation test with flying colors, but some of the other emulations appeared flawed.

The IBM Graphics Printer emulation produced beautiful results during the PC Labs emulation test but printed only one of the three pages. The Epson FX-80 emulation consistently and mistakenly ejected a page during the PC Labs emulation test.

If you've got time to burn and software that lets you tinker with its printer definitions, you can probably solve these problems. But don't expect much help from the F-1010 documentation.

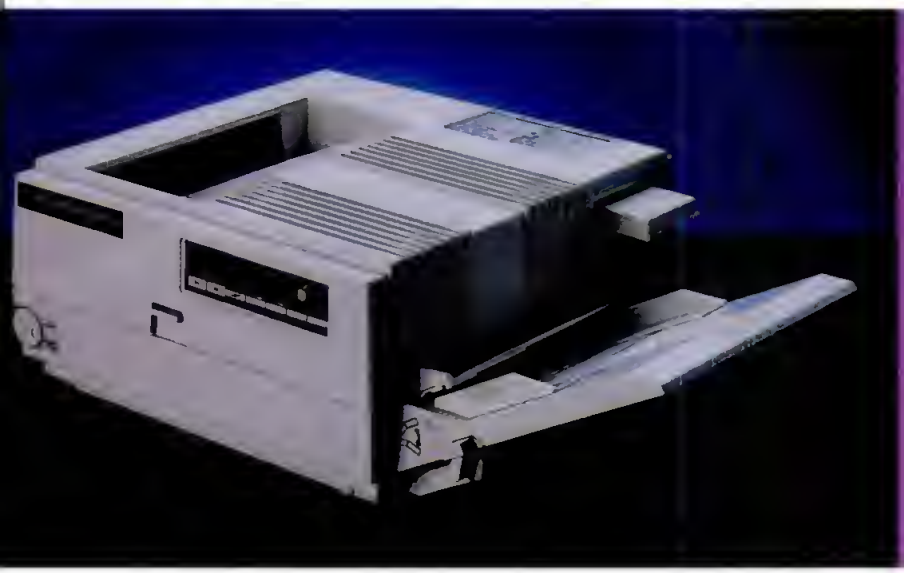
While some portions of Kyocera's documentation are excellent, others leave you flipping through the pages in vain, searching for additional information. The programming manual includes a chapter that offers notes about each emulation and lists command codes for each emulated printer. However, the 42-page section does a poor job of explaining what the codes mean or how they should be used. You get just enough information to realize that you need to dig up a manual for the printer you're trying to emulate.

A chapter or two devoted to the particulars of using the F-1010 with each of the major word processors would be a big help. Kyocera reports that such a chapter is in the works.

Besides the apparent emulation shortcomings, our evaluation unit suffered from paper-handling problems. The single, 250-page feed tray kicked up slightly with each page feed, and the feed mechanism was noisy compared to most laser printers. These oddities in themselves are not unforgivable, but the printer jammed frequently when the feed tray got down to about 50 pages. A Kyocera representative said the paper-jamming problem was unusual for the F-1010.

The F-1010's C-shaped paper path feeds pages facedown into a tray that holds about 150 pages. You can feed envelopes or odd-sized pages through a manual feed slot above the feeder cartridge, but expect a few creases in your envelopes if you do. Getting the printer up and running is relatively easy and takes only about an hour, thanks to Kyocera's excellent installation documenation.

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The Kyocera engine requires separate drum, toner, and developer cartridges, but the unit ships with the developer installed. The drum cartridge slides in from the front, and the toner cartridge drops into a bay on the top. The F-1010 will accommodate either a parallel or a serial interface.

The highlight of the F-1010's no-frills control panel is the status button, which lets you print the status sheet. The status sheet lists a wide variety of information about the printer's current settings, including margin settings, spacing, font, and emulation.

The printer defaults to the HP LaserJet Plus emulation at initial power up. Though you may find use for the other emulations, you'll want to stick with the LaserJet Plus to get the most out of the F-1010.

CLOSE CORRESPONDENCE Kyocera's 36 resident fonts correspond closely to the fonts you'd get from several HP cartridges. Whereas each of the other emulations will give your word processor access to only a few of the 36 fonts, the LaserJet Plus emulation will let you print all of those fonts and more.

When you call for a specific HP font, the Kyocera matches the font to one of its own. If it can't match the fonts exactly, it prints in the closest available. In portrait orientation, the LaserJet Plus emulation also supports raster graphics and can generate italics.

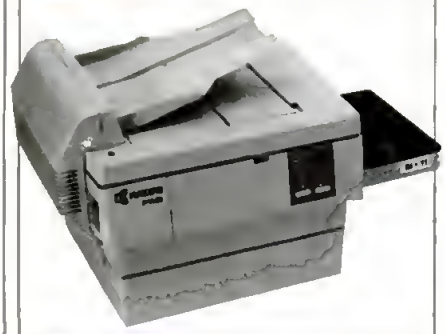
Kyocera's Prescribe command language, another strong point of the F-1010, lets you change the default printer emulation via a BASIC program or embedded codes. The user's manual includes a 14-line BASIC program that you can type and use or refer to as an example.

Besides handling mundane tasks, such as switching fonts and setting margins, Prescribe offers a few special features, such as printing bar codes and pie charts. Probably its most powerful feature lets you build upon four font templates to create new fonts. To generate a new font, you issue the GENF command along with its 12 parameters. The parameters allow you to specify character height, compression, shear (for italics), rotation, and boldface.

However, you'll be disappointed if you want to use Prescribe to construct your own printer definition for an application such as *WordPerfect*. Kyocera inexplicably omitted a few basic commands without which no printer definition would be complete. For example, you'll find no underline command, no center command, and no universal stroke-weight or italics commands.

Despite its deficiencies, the F-1010 carries the potential to be a serious contender in the laser printer arena. The Kyocera engine is fast, character formation and darkness are at least average, and the number of resident fonts is generous.—**Mitt Jones**

PC MAGAZINE FACT FILE



Kyocera F-1010
Kyocera Unison Inc.
3165 Adeline St.
Berkeley, CA 94073
(415) 848-6680
List Price: $3,695
Dimensions (HWD): 18.5 × 18.3 × 14.3 in.
Weight: 64 lbs.
In Short: A 9.2-ppm, feature-laden bargain, the Kyocera F-1010 gives you more flexibility than many laser printers costing twice as much.
CIRCLE **685** ON READER SERVICE CARD

Kyocera F-2010

The Kyocera F-2010 earns the unenviable distinction of being the slowest 10-page-per-minute laser printer we've ever had the pleasure to test. PC Labs tests clocked the $4,695 F-2010 at 6.8 ppm, a figure that any self-respecting 8-ppm printer can beat.

At the risk of whipping a dead horse, we should mention that the F-2010 even tested 2.5 ppm slower than its less-expensive sibling, the Kyocera F-1010.

But while you're waiting for your manuscripts to print, and chanting "speed isn't everything" to yourself, you can always play with the F-2010's 24-button control panel—only one of several nice features that distinguish the F-2010 from the F-1010. Also based on a Kyocera engine, the F-2010 offers the same six emulations, 36 resident fonts based on six typefaces, and good print quality as the F-1010, but it adds a straight-through paper path, an additional paper feed, the ability to store information on EEPROM cards, and an optional five-tray sorter.

The control panel makes accessing the printer's impressive range of features easy, though its display can be somewhat difficult to read from certain angles. To change the emulation, you simply depress the ready button, tap the emulation key until the display shows the emulation you want, and press Enter. Changing the character set, font, and copy count is just as easy. The control panel also lets you cancel a print job, temporarily halt printing, print a

PC MAGAZINE FACT FILE



Kyocera F-2010
Kyocera Unison Inc.
3165 Adeline St.
Berkeley, CA 94073
(415) 848-6680
List Price: $4,695
Dimensions (HWD): 18.1 × 35.5 × 14.9 in.
Weight: 68 lbs.
In Short: An impressive array of standard features, including a powerful and easy-to-use control panel, sets this laser printer apart from the competition. But at 6.8 ppm, it doesn't live up to its 10-ppm rating.
CIRCLE **684** ON READER SERVICE CARD

Small news from IBM.

Introducing a new low-priced, high-powered IBM Personal System/2.

It's called the Model 25, for short, and it comes with the power, graphics and quality that have made the IBM® Personal System/2™ family the acknowledged new leader in personal computing. What's more, it comes in a size that fits virtually anywhere and at a price that fits most any budget.

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The system works with the other members of the Personal System/2 family. And it was designed to run lots of the popular programs that are already available for IBM Personal Computers.*

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In the classroom, dorm and at home, students will love the easy-to-use design and spectacular graphics of the new Personal System/2 Model 25. Parents and school board members will especially love its small price.

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Expandable to	640KB
Diskette size and capacity	3½ inch 720KB
Expansion slots*	2
IBM Keyboard	Enhanced or Space Saving
Operating system	IBM DOS 3.3

*Model 25 has one full-size and one eight-inch expansion slot

Disk drives,** processor and display are all built into a single compact unit. Just plug it into a wall socket, attach the keyboard and it's set to go.

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IBM

*Differences in system configurations must be considered in selecting software. **Second disk drive optional. In Canada call 1-800-465-6600. © IBM 1987 IBM is a registered trademark and "Personal System/2" is a trademark of IBM Corporation

CIRCLE 740 ON READER SERVICE CARD

font sample, or print a hexadecimal dump of the data codes received from your computer.

You can even use the control panel to change the language used on the message display to French, German, Danish, Swedish, Italian, or Spanish. Unlike the F-1010, the F-2010 rarely jammed during testing, even when the feed trays were nearly empty. The straight-through paper path won't leave thick stock curled like the C-shaped path, but don't expect your envelopes to print without a crease or two.

The Prescribe command language includes all the features found in the F-1010, plus a few more to handle the F-2010's additional paper-handling capabilities. Taking the additional feed tray, the straight-through paper path, and the control panel into consideration, the F-2010 is probably a better choice than the F-1010 for a shared office machine. And the six emulations and abundance of fonts certainly put this machine above many others in its price range.

But a 10-ppm printer that prints at less than 7 ppm? Give me a break.

—Mitt Jones

Kyocera F-3010

Kyocera Unison led the way into the not-too-distant future of laser printing with the introduction of its $8,395 Kyocera F-3010 at 1987 Spring Comdex. It's not the fastest laser on the market, but it's by far the fastest laser printer with a four-figure price.

The F-3010 looks identical to Kyocera's F-2010, from its high-tech control panel to its nice assortment of paper-handling appendages. But the F-3010's rated 18-page-per-minute engine leaves the F-2010 choking on its toner.

We clocked the printer at 15.6 ppm running at its defaults—the HP LaserJet Plus emulation printing a 10-character-per-inch Courier font. While well-below 18 ppm that's still twice as fast as most of the competition. Although the F-3010's speed isn't that noticeable or important when printing only a page or two, it's a real time-saver for lengthy documents.

Besides HP LaserJet Plus emulation, the F-3010 emulates the Diablo 630, Epson FX-80, IBM Graphics Printer, NEC Spinwriter, and Qume Sprint 11. We found some problems with the emulations, most involving erroneous page breaks or spacing, but the emulations are probably as good as you'll get with most printers.

Our evaluation unit came with 36 fonts based on six typefaces—Courier, Helvetica, Letter Gothic, Prestige Elite, Times Roman, and Line Printer.

According to Kyocera, however, the F-3010 will be shipping with 78 resident fonts by the time our printer issue hits the newsstands. The additional fonts will offer more variations of the same six type styles.

To get the most out of the F-3010, you'll want to use the HP LaserJet Plus emulation for most applications. Each of the resident emulations corresponds to an HP cartridge font, so any application that fully supports the LaserJet Plus should give you access to all 36 fonts. The F-3010 automatically matches the HP font to the closest Kyocera font. It also automatically generates a requested italic font if that font isn't already available.

The F-3010 can also download both Hewlett-Packard and Kyocera fonts, but you might be better off creating your own. You can create just about any font you'll need by using Kyocera's powerful Prescribe command language.

Prescribe's GENF command lets you build your own font by modifying any of four font templates. You specify character height, compression, shear (for italics), rotation, and *x* and *y* boldface printing. This flexibility lets you create fonts you never dreamed of needing, such as a half-inch high, compressed, upside-down Helvetica typeface with horizontal bold only.

Prescribe also includes graphics commands you can use to print circles, boxes, and pie charts, and you can print a wide variety of bar codes with Prescribe's BARC command.

One of this printer's nicer features—a 24-button control panel with a small, backlit-LCD—lets you control most options you'll need on a regular basis without using Prescribe.

Using the panel to control paper-handling options, emulations, fonts, and other features is surprisingly easy and intuitive. You can also use it to print font samples and a status sheet that shows the value of about 50 current printer settings.

Like the F-2010, the F-3010 sports both a facedown, C-shaped paper path and a straight-through paper path. The paper-feeding mechanism, though somewhat noisy, rarely jammed and seemed fairly well designed. I did, however, encounter some problems persuading the manual-feed to accept envelopes, and both paper paths creased the medium-weight envelopes I tested. Kyocera offers an optional, five-tray sorter for $600.

Kyocera's user manual does an excellent job of leading you through the relatively painless installation steps, and the programming manual does an equally nice job of laying out the many Prescribe commands.

The chapter dealing with the printer emulations, however, lacks the detail you need to fully exploit the printer's features. Though Kyocera lists supported command codes for each of the emulations, you won't find any explanation of how to use

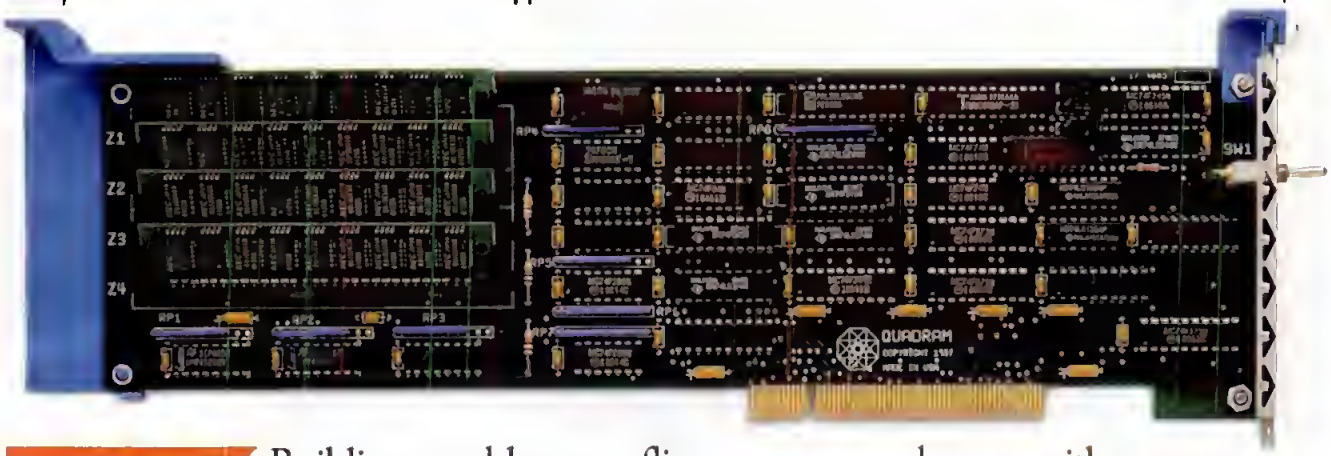
PC MAGAZINE FACT FILE



Kyocera F-3010
Kyocera Unison Inc
3165 Adeline St.
Berkely, CA 94073
(415) 848-6680
List Price: $8,395
Dimensions (HWD): 18.13 × 35.5 × 14.88 in.
Weight: 70.6 lbs.
In Short: This 15.6-ppm model would merit applause even without its lengthy list of standard features. Whether its ground-breaking speed and impressive array of fonts are worth its price is another issue.

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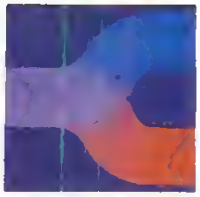
Building great memory into your PS/2™ Model 50 or 60 takes more than just stuffing a board. It takes intelligence.



Not one Micro Channel™ ID, but three—a primary and two back-ups. Avoids conflict with other boards that could cripple your system.

You need a memory board that's smart enough to anticipate potential problems and solve them if they crop up. Problems like two boards fighting over the same address, or boards not meeting the squeaky-tight specs that IBM has set down for PS/2 enhancements.

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Also, you need a board that's smart enough to save you steps in your everyday work. To start up each day without a hassle. Smart enough to switch easily between extended and expanded memory.

And smart enough to grow as you need more memory. From a family of PS/2 enhancements that keeps your computer open to change and growth.



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IBM, PS/2, OS/2, Micro Channel/International Business Machines Corp

CIRCLE 181 ON READER SERVICE CARD

these codes with your F-3010 printer.

All in all, there's not much wrong with the F-3010. Its ground-breaking speed, impressive array of fonts and emulations, and full paper-handling features would seem to make it a Cadillac of laser printers.

But you'll also pay a Cadillac price. At $8,395, the rugged F-3010 is far from cheap. If your department is ready to move up to laser printing and has eight grand to blow, why not buy two LaserJets and all the HP font cartridges your heart desires?
—Mitt Jones

The Laser Connection Big Kiss II

You'll have three reasons to smile at The Laser Connection's new $4,495 laser printer, The Laser Connection Big Kiss II: its name, its relative ease of use, and its performance. Besides offering four emulation modes—Epson, Qume, Diablo, and ANSI X3.64—the Big Kiss II accepts optional font cartridges. It has a maximum resolution of 300 by 300 dots per inch and a measured speed of 7.5 pages per minute. While others may smirk when they see the logo or hear the name, users of the Big Kiss know that when you find out how easy it is to operate the printer as compared with other laser printers, you'll feel like giving it a big kiss, or at least a fond pat.

The Kiss series of laser printers are now being sold through The Laser Connection, a subsidiary of QMS, which also gives us a number of other laser printers reviewed in this issue, including the QMS PS-800 Plus, the QMS SmartWriter 80 Plus, and the Laser Connection PS Jet. As in the other Kisses from The Laser Connection's line, a Canon engine lies at the heart of the Big Kiss II.

Thanks to the Canon engine and the parallel port, installing the Big Kiss II is easy. You simply connect a cable, insert the green felt Corona wire, slip the EP print cartridge through the side door, remove the plastic separator, and turn on the power. Unlike Ricoh's loose toner cartridges, Canon's EP cartridge ensures no-mess operation.

In fact, the only problem you may encounter is lifting the 99-pound printer from its box. Even if the Big Kiss II were somewhat lighter, the 18.7 inch-height makes it awkward for one person to hold.

Like other laser printers, the Big Kiss II automatically outputs a status sheet when powered up. The status sheet displays the default settings, including emulation, margins, and orientation; the built-in fonts, with the selected fonts highlighted; and the number of pages printed to date. Because you can also print the status sheet other times at your convenience, you can use the value of the number of printed pages as a means of tracking printer usage and gauging maintenance due dates.

SELECTING FEATURES You can select any of the features, such as emulation mode and font type, either by pressing the touch-sensitive controls on the front panel or through escape code sequences. If you think that using the front panel is easier than using escape codes, though, you are mistaken—it's not easier, only more convenient, and only if the manual is on hand. Unlike the 20-character LCD on CIE's LIPS 10, the LED on The Laser Connection's Big Kiss II displays only two characters. Consequently you'll probably find yourself referring back to the manual to decipher the various codes.

While many laser users have learned that code 11 means out of paper, novices have not, and even power users need to unearth the manual whenever a strange code appears. It would be so much better if Canon allowed its original Equipment Manufacturers (OEMs) to install an LCD that displays English messages.

The front panel controls are divided into function and configuration keys. The function keys allow you to feed forms, toggle between on- and off-line, redirect the paper feed to the manual feeder, and print examples of the available fonts. With the three configuration keys, you select the group and the option categories, and enter new values.

Switching from one emulation to another is so easy that you can create documents with features from all of the emulated printers. For example, you can mix Diablo word processing commands with Epson graphics within the same report. Of course, to do so requires a knowledge of printer programming, since off-the-shelf software rarely allows for switching from one emulation to another within a report.

The various emulations are complete except for a few commands, the vast majority of the nonsupported commands having to do with such features as printhead directionality, ribbon color, and immediate printing mode. While the Big Kiss II is set to recognize the complete set of IBM extended characters, you need to send an escape code if you want to print all of them as characters.

Despite all its emulations, the Big Kiss II lacks a document description language. Without one, its usefulness is somewhat hampered. After all, Epson emulation may be more than adequate for printing Lotus graphics and *WordStar* documents, but it falls a little short when outputting a desktop publishing document. True, you can fudge with the ANSI emulation, but the most popular page description language

PC MAGAZINE FACT FILE



The Laser Connection Big Kiss II
The Laser Connection
A Subsidiary of QMS
7852 Schillinger Park West
Mobile, AL 36608
(800) 523-2696
(205) 633-7223
List Price: $4,495
Dimensions (HWD): 18.7 × 19.5 × 18.1 in
Weight: 99 lbs.
In Short: This 7.5-ppm Canon-engine laser printer is a dual-bin version of the original Big Kiss, offering four emulation modes and ease of use.

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supported by desktop publishing packages is still Adobe's PostScript.

FONTS The Big Kiss II comes with 14 built-in fonts, three of which are landscape oriented. They include three Epson fonts (compressed, elite, and pica), two Courier 10 fonts (portrait and landscape), two Prestige Elite fonts (upright and italic), one 12-character-per-inch Letter Gothic font, two 10-point Hamilton Medium fonts (upright and italic), two Q-Roman fonts (upright and italic), and two upright Q-Format landscape fonts (8 point and 5 point). The specifications also list the Epson Italics character sets as additional fonts.

The Q-Roman font is a thin but graceful 12-cpi font that looks its best when spaced proportionally. Q-Format is a no-nonsense, legible font that facilitates the printing of large spreadsheets. For a thick sans serif font, you'll probably use the 10-point Hamilton fonts.

The most obvious design departures in the Big Kiss II are the inclusion of a second paper tray (making the total capacity 500 sheets), commands to support the additional tray, and the ability to output pages faceup or facedown. While the Big Kiss II's size precludes it from sitting on a desktop alongside a PC, it is appropriate for a dedicated table stand in networking situations. In particular, the double paper cartridges should please those who have heavy workloads or use two types of stationery.

> Besides offering four emulations—Epson, Qume, Diablo, and ANSI X3.64—the Big Kiss II accepts optional font cartridges.

The Big Kiss II comes with a total of 640K bytes of memory. Of that, 256K is dedicated to page memory description, and 384K for system ROM. You can share 176K bytes between the font download memory area and the print buffer. The minimum amount of memory you can delegate to the buffer is 132K bytes.

The Big Kiss II has a few things going for it: a respectable number of built-in fonts, emulation of popular printers, and well-organized manuals. By the same token, though, it lacks an easy-to-comprehend front panel display and a document description language. But if you need an inexpensive laser printer to act as a network printer—and you always have your manuals at hand and don't do desktop publishing—you may stop looking after you've seen the Big Kiss II.

—Vincent Puglia

The Laser Connection PS Jet

The Laser Connection has graduated with honors, and so have its PS Jet and PS Jet Plus. No longer exclusively add-on units for Canon-based laser printers, the $4,995 PS Jet and $5,495 PS Jet Plus are now available as full-fledged laser printers, emulating, respectively, the Apple LaserWriter and LaserWriter Plus.

Other than cost, the primary difference between the PS Jet and the PS Jet Plus is that the 2-megabyte Plus version offers more fonts than the 1.5-megabyte standard version. The PS Jet includes various roman, italic, and bold fonts in Times Roman, Helvetica, Courier, and Symbol. The PS Jet Plus, which was not available for review, has fonts in those typefaces, plus ITC Avant Garde Gothic Book, Helvetica Narrow, Palatino, New Century Schoolbook, ITC Bookman Light, ITC Zapf Chancery Medium Italic, and ITC Zapf Dingbats, according to the vendor.

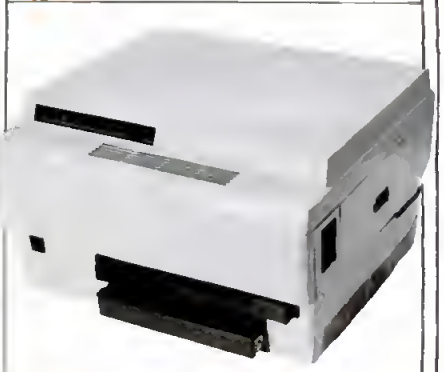
Both of the PS Jets are based on the Canon engine, which means that solids in your graphics printouts appear solid only up to a point. And both printers have a 5,000-hour mean-time-between-failures (MTBF) rating.

QMS RESEMBLANCE The PS Jet and PS Jet Plus are priced competitively with the corresponding Apple printers. But the two printers also offer Diablo 630, Hewlett-Packard LaserJet Plus, and Hewlett-Packard Graphics Language emulations. If that emulation versatility sounds a lot like that of the QMS PS-800 series, it should: The Laser Connection is a wholly owned subsidiary of QMS. That's why it's not surprising that the Canon-based PS Jet Plus and the Canon-based QMS PS-800 Plus are essentially the same PostScript printer, both emulating the Apple LaserWriter Plus as well as the HP LaserJet Plus, the Diablo 630, and HP Graphics Language plotters. Both cost and look the same, offering the same features and 6.25-page-per-minute print speed.

The differences between the QMS and Laser Connection printers are more intriguing than the similarities. The most notable difference is that The Laser Connection's printers reflect more concern for the people who use them. This user friendliness gives the PS Jet and PS Jet Plus a slight edge over the printers that bear the parent company's label.

The PS Jet manual is the first indication

PC MAGAZINE FACT FILE



The Laser Connection PS Jet
The Laser Connection
A Subsidiary of QMS
7852 Schillinger Park West
Mobile, AL 36608
(205) 633-7223
List Price: $4,995
Dimensions (HWD): 11.4 × 35.8 × 18.7 in.
Weight: 55 lbs.
In Short: A versatile 6.25-ppm Canon-based laser printer that emulates the Apple LaserWriter/LaserWriter Plus, the HP LaserJet Plus, the Diablo 630, and the HP Graphics Language plotters; a clear, informative manual and the handy setup and test disk sets this printer apart from the pack.

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PROJECT: CRYSTAL JET

MODEL KE-300

- HIGHEST QUALITY TEXT AND GRAPHICS
- EMULATES 9 POPULAR PRINTERS
- 300 DPI FULL PAGE GRAPHICS
- SCALABLE FONTS TO ANY SIZE

PROJECT: CRYSTAL VIEW

MODEL 1901/TX-1280

- 19 INCH HI-RES DISPLAY
- 1280 x 960 RESOLUTION
- INTEL 82786 GRAPHICS CO-PROCESSOR
- DUAL PAGE DISPLAYABLE

PROJECT: CRYSTAL SCAN

MODEL 3001/MAC

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- 64 GREY LEVELS
- OPTICAL CHARACTER RECOGNITION
- IBM AND APPLE MODELS AVAILABLE

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To set up the SX, just plug it in and define the ports using the switches and software provided. Concise documentation tells you how. If you have a question, call our toll-free support line.

When someone's ready to print, they simply use the handy little menu that pops up on screen with the names you've chosen. Call your printers Martha, Chatterbox, Relic, whatever.

The SX does the rest. It handles interface conversions, making parallel and serial machines work together. Yes, it even lets IBM® and compatible PCs share a laser with no fiddling. And PCs can exchange files with communications software.

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that The Laser Connection cares. A glance through the table of contents shows the logical organization of topics, and the writing is clear and concise. Unlike the manual for the equally versatile QMS PS-800 Plus, it includes HP LaserJet, HP Graphics Language, and Diablo 630 command summaries to make your work easier.

SETUP EXTRAS More remarkable than the helpful manual is the PS Jet setup and test disk. IBM-based users of the Apple LaserWriter have been yearning for a tool like this one. In addition to providing such main menu selections as Align PS Jet, Print PostScript Samples, Change Printer Name, Set Printer Protocol, Manual Feed Control, and Exit to DOS, the PS Jet setup and test disk allows you to do the two most necessary tasks required when using any PostScript-based printer: change the handshaking from XON/XOFF to DTR (and back again) and change the printer's name. Rather than forcing you to sort through the correct PostScript code and then stumble on the right syntax, The Laser Connection has reduced the process to two very simple menu selections. For this act of common sense alone The Laser Connection deserves applause.

PostScript aficionados will immediately realize that for the printer to provide DTR support, the version of PostScript included with the standard PS Jet must be a later version than that which Apple included with its original LaserWriter. It is—and even though the standard PS Jet is a scaled-down printer, it is not old merchandise being sold off from inventory. With the exception of fewer fonts and less memory, the PS Jet offers the same level of performance as the PS Jet Plus, according to the vendor. So if you can make do with 1.5 megabytes and Times Roman, Helvetica, Courier, and Symbol fonts, the PS Jet's lower price can clip $500 from your initial investment in a PS Jet Plus.

Upgrading the printers later won't be a problem, since both versions come with ample memory to support downloadable fonts. (HP fonts are available from The Laser Connection for $199; Adobe PostScript fonts will be available soon.)

Of course, if you already own a Canon-based laser printer, you can still purchase a PS Jet controller board ($2,995) or PS Jet Plus controller board ($3,495) as an electronics-only add-on unit. After about an hour of relatively simple disassembly and reconstruction time, your old printer will perform as though it had always been a PS Jet or PS Jet Plus.

Whether you put the parts together or let the vendor do the job, the features of the versatile PS Jet and the TLC shown by The Laser Connection—in the manual and especially with the inclusion of the handy setup and test disk—put it at the head of the class.—**Carol Olsen Day**

The $3,695 Mannesmann Tally 910 laser printer just may be the chameleon of PC products. With five resident emulations, the 910 can assume almost any identity you want it to.

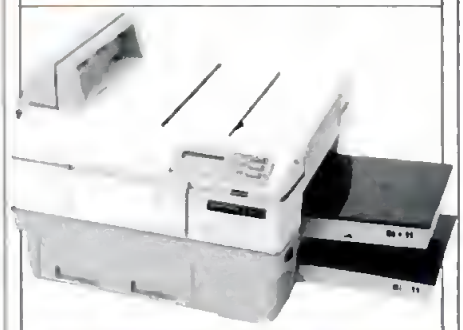
The 910 goes beyond the minimum mimicry of most lasers, which emulate only one or two different printers. The most popular are the HP LaserJet Plus, the Epson FX-80, and the Diablo 630, which together let you run almost any software since they cover the laser, dot matrix, and daisy wheel markets fairly thoroughly. To these standards, the Mannesmann Tally 910 adds another daisy wheel with the Qume Sprint 11 Plus and covers important dot matrix territory with IBM Proprinter emulation. With all these options from which to choose, many users may find that they do not have to reconfigure their current software to use this printer.

Selecting an emulation is made easy by the 910's front-panel programming features. The 16-character LCD window prompts you with the different options for a variety of parameters, including emulation mode, number of copies, font, paper input source, paper output destination, and more. You scroll through the different parameter categories and make changes as desired. The changes stay in effect even after you turn the printer off and back on again. Should you get everything mixed up and not want to go through and try to change them back to the default, there is also an option that will automatically reset all parameters to the original factory settings. This feature makes experimentation a lot less risky.

Once you have selected your parameters, you can choose one of four different test print pages. In addition to the familiar "ripple" or "barber pole" page showing the printable characters, a pinstripe page and a graph paper page demonstrate the engine's print quality, and a status report lists all the current parameter settings and available options.

FLEXIBLE FONTS The 910 shows almost as much versatility in its fonts as it does in emulation choices. It comes with only three type styles, all of which are mono-spaced: Courier, Prestige, and Gothic. These print in 10, 12, and 16.67 pitch, respectively. The 910 effectively triples the number of fonts available in that it can print any resident font in either boldface or italic without relying on a separate font. In addition, it can also print in reverse, showing white letters on a black background. This reversal can be an effective attention grabber and is a feature that

PC MAGAZINE FACT FILE



Mannesmann Tally 910
Mannesmann Tally Corp.
8301 S. 180th St.
Kent, WA 98032
(206) 251-5500
List Price: $3,695
Dimensions (HWD): 33 × 18 × 11 in.
Weight: 71 lbs.
In Short: The Mannesman Tally 910 is a solid performer with some attractive features, such as five printer emulations and a measured speed of 9 ppm. But its lack of fonts, average memory, and fair graphics print quality make it less than competitive at its list price.

CIRCLE 645 ON READER SERVICE CARD

not many other laser printers offer.

Many of these options can be accessed using 910-specific escape sequences. These commands are similar to those of the HP LaserJet command set yet do not conflict with them since they use an "<Esc> { s" prefix, as compared with the LaserJet "<Esc> (s" prefix. The italic and boldface attributes may also be called through the emulation commands, if those are available options in that command set.

I tested the HP LaserJet, Epson, and IBM Proprinter emulations with generally good results. For the HP LaserJet mode, the commands were executed without mistakes. The print quality on the graphics portion of the test was not on a par with the best of the competition, however. There was a little toner washout on the dense black portions, and the pinstripe shading of the test's circle pattern was not as sharp as it should have been. The graphics print quality was not consistent from one page to the next.

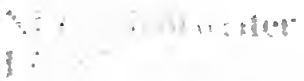
Under the Epson emulation, the printer had the same problems as many other lasers; the titles for the test images were printed on separate pages from the graphics themselves. The IBM Proprinter emulation handled the graphics-emulation test without a problem.

The text handling features of the emulations were excellent. In addition to producing italic and boldface fonts, the 910 was able to print the correct high-order characters for each emulation. This means accented foreign language characters in the HP mode, italic in the Epson mode, and perfect PC character graphics compatibility in the Proprinter mode (except that the light-shaded full cell—ASCII 177—came out solid black on the 910).

EASY OPERATION The printer is built around the Kyocera print engine. Rated at 10 pages per minute, the 910 cranked out a respectable 9 ppm in the PC Labs tests. The engine uses separate consumable components, which adds slightly to the complexity of initial set up and maintenance. Compared with other designs that take the separate item approach, however, a Kyocera-based machine is one of the easiest to load and run. It does suffer from the fact that users must handle an exposed optical drum when changing components, which could unnecessarily damage this sensitive and expensive item.

The manual is well organized with tabbed dividers and also has plenty of illustrations. Each tabbed page also lists a table of contents for the chapter that follows it, which makes it easier to locate desired information. The manual includes separate sections on the command sets for each emulation mode. On the up side is the fact that all commands in the target printer command set are listed, including an important table of the commands that are not supported by the 910. (There are no commands listed as unsupported for the HP LaserJet Plus emulation, and I did not spot any that were missing.) On the down side, there is almost no explanation of any of the emulated commands. But the manual does an adequate job of explaining the superset commands that are peculiar to the 910.

The Mannesmann Tally 910 is an interesting printer with a good deal of flexibility. Unfortunately, it falls down a bit in the value category. Priced at $3,695, it costs at least 40 percent more than many comparable printers. With only one interface port, only three type styles, fair graphics print quality, and just the usual 500k bytes of memory, its assets of extra emulations and raw print speed are not enough to warrant the extra money. It is a solid performer that might be attractive at a lower price.
—Alfred Poor



At first glance, NEC Information Systems' $2,295 NEC Silentwriter LC-850 resembles a square '30s-era washtub complete with board. Once you begin using the NEC-engine Silentwriter LC-850, though, you'll appreciate its relatively small footprint and its capabilities. It has two emulation modes (IBM Proprinter and NEC 5550, but not HP LaserJet), a feature-packed front panel, collated output, and a speed of 7.6 pages per minute.

Because the NEC Silentwriter LC-850 comes with both parallel and serial interfaces, it offers a certain amount of flexibility not available with other printers. Installing the toner is not as easy as slipping a Canon EP-cartridge into an HP LaserJet, but it's not much more difficult. Simply place the cartridge over the bin, pull the cord, and the toner falls into place.

At the rear of the printer are three banks of easily accessible DIP switches that you can set either manually or through software. Among the features you can access are emulation, pitch selection, paper size, line-feed (with or without a carriage return), bps rate, parity, and protocol. A fourth set of switches, located inside the printer, allow you to adjust the print position (horizontal or vertical) and the printhead LED lighting time.

Because the NEC Silentwriter LC-850 comes with parallel and serial interfaces, it offers a certain amount of flexibility not available with other printers.

The front panel includes a 16-character LCD window to display messages. The panel does not give you all the information you would like at hand or allow you to set every feature, but it does let you access options much more easily than with an HP LaserJet. In addition to low toner and warm-up messages, it also shows the currently selected font and makes choosing a font much easier than the two-character codes displayed by most printers. The four touch-sensitive controls are for cycling through the available font sets, selecting manual feed, sending a form-feed, and putting the printer on- and off-line.

The paper tray resembles a cut-sheet-feeder more than it does the usual paper cassettes: it stands almost vertically at the rear. The hopper has a 250-sheet capacity, and a second hopper with the same capacity is optional. Paper flows down into the printer, around, and up again, surfacing on the top, facedown. The result is collated output.

The Silentwriter LC-850 comes with both IBM Proprinter emulation and NEC

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CIRCLE 348 ON READER SERVICE CARD

5550 emulation, as well as a set of escape code sequences called FS (form separator). Four fonts are built in: three for portrait orientation (10-pitch Courier, 10-pitch Courier Italic, and 10-pitch Courier Symbol) and one for landscape orientation (12-pitch Courier). Optional font cartridges slide into the two slots at the bottom of the printer.

The LC-850 can output 5, 6, 10, 12, and 17.1 character per inch as well as proportional spacing. And besides bold and shadow print, it offers dot mesh (Benday) and reverse print.

The IBM Proprinter emulation leaves much to be desired. For one thing, it has no provision for switching from roman to italic through Proprinter commands. For another, if you do not activate the pitch-selection option on one of the DIP switches, the characters in condensed print will run together.

PC MAGAZINE FACT FILE



NEC Silentwriter LC-850
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 343-4418
(617) 264-8000
List Price: $2,295
Dimensions (HWD): 10.9 × 18.5 × 20.7 in.
Weight: 68 lbs.
In Short: This dual-emulation 7.6-ppm NEC-engine printer offers collated output in both NEC 5550 and IBM Proprinter modes; lack of Epson, HP, and PostScript emulations limits it to straightforward text printing.

CIRCLE **455** ON READER SERVICE CARD

The manual includes a handy quick-reference guide and an index, as well as numerous diagrams, illustrations, and programming examples.

At 7.6 ppm, the NEC Silentwriter LC-850 is one of the fastest factory-rated 8-ppm laser printers on the market, and its $2,295 price tag makes it affordable to many people. Its IBM and NEC emulations give it compatibility and flexibility. But its lack of Epson, HP, and PostScript emulations narrows its usefulness to simple word processing and report-generation applications.—**Vincent Puglia**

NEC Silentwriter LC-890

If the $4,795 NEC Silentwriter LC-890, from NEC Information Systems, weren't so big and heavy, I would have carried it home with me. Functionally, it gives me almost everything I could want in a laser printer. Although basically a PostScript implementation, the 6-page-per-minute NEC Silentwriter LC-890 also includes HP LaserJet Plus and Diablo 630 emulation switchable from a front-panel menu. It prints clean dark copies, is sturdy, and well-built, and gave me almost no problems.

The NEC Silentwriter LC-890 has an unusual design for a laser printer and at first glance might be mistaken for a chunky daisy wheel printer. The two paper bins, each holding 250 sheets, extend upward from the back of the printer. The paper is collected facedown and is collated in a deep cavity on top. There's a real advantage to this design—the NEC Silentwriter doesn't need any trays that normally protrude from the sides of most other laser printers. The paper bins add only 3 inches of depth beyond the printer's footprint.

The NEC Silentwriter LC-890 solves a basic problem that until now has prevented me and many other people from buying a PostScript laser printer. Although PostScript is fast establishing itself as a standard page composition language for PCs, many PostScript printers (such as the Apple LaserWriter) add only a simple nongraphics Diablo 630 emulation mode for non-PostScript software. So, if you want to do graphics or fancy text printing from a software package that doesn't support PostScript, you're out of luck.

The NEC Silentwriter LC-890 fills the gap. With it, you have PostScript for the really smart programs, such as *Microsoft Word* and *Windows*, that know about page composition; you have HP LaserJet Plus emulation for the bulk of the programs, such as *1-2-3*, that can work with different fonts and graphics; and you have Diablo 630 emulation for more ancient and primitive programs, such as *WordStar*.

NO CODES OR SYMBOLS The emulation modes, the hardware interface, and several other options are all selectable from the front panel using three buttons labeled menu, next, and select. As you descend through a nested menu, the options

EDITOR'S CHOICE
PC MAGAZINE FACT FILE

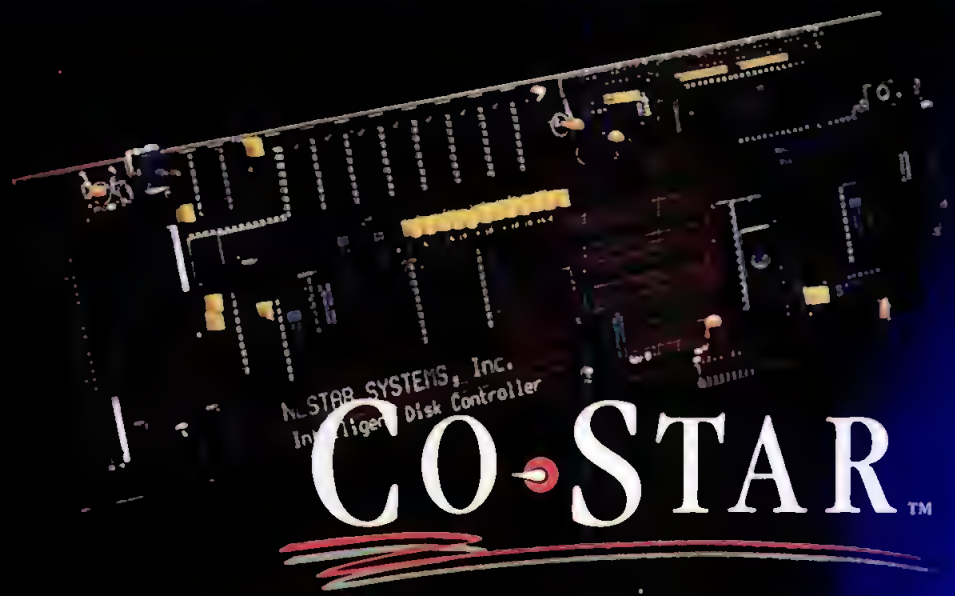


NEC Silentwriter LC-890
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 343-4418
(617) 264-8000
List Price: $4,795
Dimensions (HWD): 18.3 × 22 × 23.5 in.
Weight: 68 lbs.
In Short: An excellent 6-ppm laser printer for office work requiring PostScript, its HP LaserJet Plus and Diablo 630 emulation modes make this laser useful with non-PostScript software as well.

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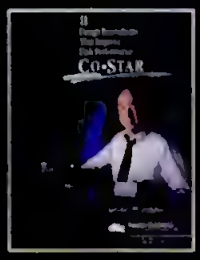
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are shown in an alphanumeric LCD display. The LCD display also serves as a status indicator, using real words such as "add toner" rather than codes or symbols.

As a PostScript printer, the LC-890 includes all the fonts found in the Apple LaserWriter Plus. Like the LaserWriter, the printer has a serial port and an AppleTalk port. Unlike the LaserWriter, it also has the parallel port that most PC users prefer for hassle-free setup.

For Diablo 630 emulation, you can select any of Courier, Helvetica, or Times Roman typefaces in bold, italic, or oblique versions as the standard font; you can use any other typeface for the boldface font, using either 10, 12, or 15 pitch. Normally you would select the mono-faced Courier when using Diablo emulation.

The emulation of the HP LaserJet Plus uses the PostScript Courier, Helvetica, and Times Roman typefaces. The emulation software will recognize any type size specified in an HP LaserJet command sequence for these three typefaces. All fonts are printable in portrait or landscape mode.

The PostScript supplementary manual that NEC supplies with the Silentwriter LC-890 points out some relatively minor problems in the HP LaserJet emulation mode. One involves justified text: an HP LaserJet printer driver bases justification on the character widths of the fonts stored in the LaserJet; the Silentwriter LC-890 emulation uses instead the PostScript Helvetica and Times Roman fonts, which have slightly different widths. The manual indicates that this is not a serious discrepancy. I tried out some justified text in the LaserJet emulation mode using *Windows Write* and agreed with NEC's assessment.

The PostScript supplement also notes that 11 of the HP LaserJet Roman-8 symbols are not available in the PostScript fonts. On the other hand, the NEC Silentwriter LC-890 has 3 megabytes of memory, so creating full-page graphics at 300-dot-per-inch resolution is not a problem in the emulation mode.

The only problem I experienced with the NEC Silentwriter was some paper jamming that I finally traced to a small piece of Styrofoam caught underneath a metal paper guide on the inside of the printer. After I removed that obstruction by running a piece of paper under the guide, the printer once again worked flawlessly. Although the manual has several pages on dealing with paper jams, it does not mention the possibility of something getting caught underneath this guide as a potential cause of problems. It seemed to me a fairly obvious place where debris could accumulate.

Other than that, I have no complaints about the NEC Silentwriter's operation and functionality. If it were only a little smaller and a little lighter, my enthusiasm would be unbridled. Perhaps the consolation is the knowledge that the NEC Silentwriter LC-890 can probably withstand some very rough treatment.

—Charles Petzold

Oasys LaserPro Express

The Oasys LaserPro Express, from Office Automation Systems, offers 300-dot-per-inch laser technology for only $1,895—a price that you could easily wind up paying for a good daisy wheel or dot matrix printer. As you might expect at that price, the LaserPro Express is the no-frills printer in the Oasys LaserPro line. But "no frills" in this case doesn't mean "no features": throw something the LaserPro Express's way, and it's likely to be able to handle it.

One thing the printer can handle well is emulating industry standards: the IBM Proprinter, Epson FX-80, Diablo 630, NEC 3550, and HP LaserJet. And for maximum flexibility in connecting to your computer, the LaserPro Express comes with both a parallel and a serial connector.

Built-in fonts on the LaserPro Express include Courier, Elite, and Vetica (a Helvetica look-alike). Six downloadable fonts come standard on disk to round out the HP LaserJet emulation. Other downloadable fonts are also available.

If you prefer to use font cartridges, Oasys offers a $200 option that enables the printer to accept HP font cartridges. If you buy the printer without the option, you can add it later as an upgrade.

The LaserPro Express uses an engine built by the Tokyo Electric Co. to Oasys specifications. Setting up the printer involves placing a toner cartridge into the hopper of a developing unit, hooking the developing unit onto a separate drum unit, and then placing the combination of developing unit plus drum into the printer.

Installing the toner and drum is not difficult once you know how, but the installation guide is less than helpful for first-time users. The illustrations are confusing, and the accompanying text is limited to vague comments.

You may also get lost trying to connect the printer to a computer. The manual omits discussion of such a basic point as how to choose between the printer's parallel and serial ports.

Oasys is aware of the shortcomings, and the manual is currently being rewritten. If you do buy the LaserPro Express, be sure to get a new manual when it becomes available.

Apart from the installation instructions, the manual is reasonably useful. An introductory chapter touches on each of the

PC MAGAZINE FACT FILE



Oasys LaserPro Express
Office Automation Systems Inc.
8352 Clairemont Mesa Blvd.
San Diego, CA 92111
(800) 732-4589
(800) 732-4588 (in Calif.)
List Price: $1,895
Dimensions (HWD): 12.5 × 16 × 21 in.
Weight: 50.6 lbs.
In Short: Based on an engine built to Oasys specs by Tokyo Electric Co., this capable, no-frills laser printer offers a speed of 7.4 ppm and typical laser print quality; it emulates many popular printers, including the HP LaserJet.

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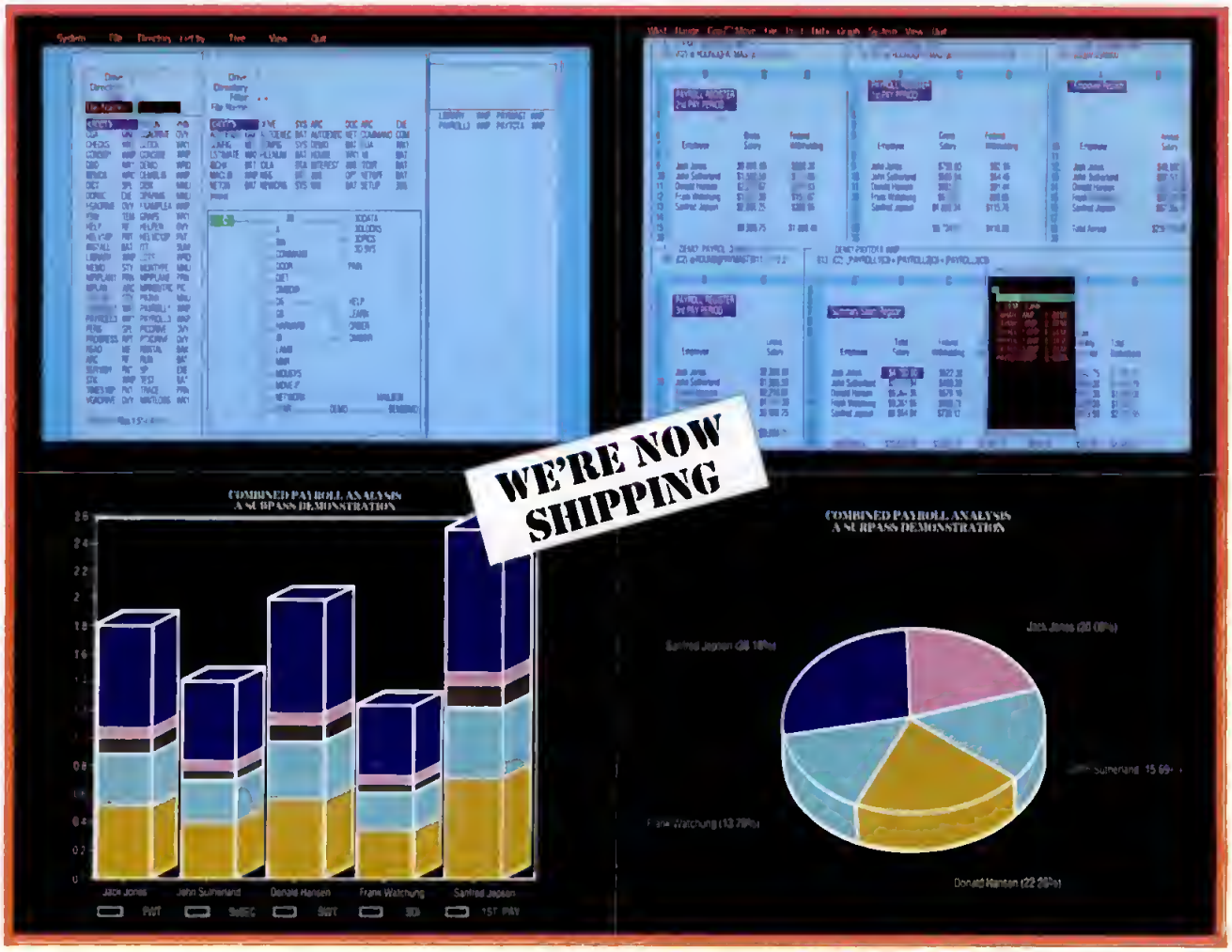
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printer's features and refers you to later chapters that go into each feature in depth. Also included are sections on the control codes for each emulation and a section explaining how to switch fonts within each emulation.

USING THE COMMANDS The LaserPro Express command language is the native set of commands for the printer. It will let you change fonts, set character spacing, control print enhancements, select orientation, and otherwise give you the control you expect.

The printer's commands are designed to be unique. Each command starts with the sequence: left parenthesis, O, right bracket, "O". Because there is no chance of confusing these commands with any of the Escape commands in the emulation modes, the printer is designed to respond to the LaserPro Express commands no matter what emulation mode it's using. This method makes it easy to change a font or print orientation by software command without having to worry about the printer's current emulation.

The LaserPro Express looks like a shortened designer cube. The paper tray is flush with the front of the printer, and the exit tray is a molded depression in the printer's top. Paper comes out facedown, automatically collated. The front panel includes six touch-sensitive switches and several error lights.

Like many recently released printers, the LaserPro Express has rejected DIP switches in favor of storing settings in nonvolatile memory. Whenever you turn the printer on or press the test button, the LaserPro Express prints the current settings in a status sheet. The status sheet covers everything from interface setting to printer emulation to current font. It also indicates such information as the fonts currently in the printer.

Alas, you need to keep the manual and status sheet close at hand to adjust the printer. The front panel includes a small LED alphanumeric display, but each setting is referred to as a code. Printer emulation, for example, is P1, and the settings are 0 through 7.

To change a setting through the front panel, you set the printer off-line; the LED then displays a code. To change the code, you use the up and down arrow keys. Pressing the value button shows the current value, and using the arrow keys moves you through the values. When you reach the value you want, you hit the Enter button. The procedure is simple enough but clumsy, requiring you to look up the codes and their values.

Print speed is an important advantage of any laser printer. The LaserPro Express is rated at 8 pages per minute; it scored 7.4 ppm on the PC Labs speed test. As with other laser printers, you endure a seemingly interminable wait before the printer produces the first page, but that drawback comes with the technology.

PRINT QUALITY Evaluating laser print quality can be a highly individual consideration, depending to some extent on the eye of the beholder. The LaserPro Express is one of the vast majority of laser printers whose output looks more like a copy than an original. Text is visibly less crisp than the characters produced by a good daisy wheel printer. If you're willing to accept output that looks like a good copy, you won't mind the result.

In addition, the LaserPro Express has a potential print quality problem—one it shares with all laser printers having drums that are unprotected by cartridges. When installing the drum, it's easy to dirty the surface by touching it. The result is a slight flaw that shows up on every printed page and adds to the "copied" look of the output. In most cases you can clean the drum with alcohol and a soft cloth, but such housekeeping tasks are a bother.

The LaserPro Express generally performed well on the PC Labs tests. It passed the HP LaserJet graphics emulation test with ease. On the graphics test, however, the printer's Epson FX-80 emulation mode worked with PC Labs' MX-80 graphics, not with FX-80 graphics. This discrepancy is a small one but important to know when installing software for the printer.

Another potential problem is memory. The printer comes with 512K, which—although sufficient for most purposes—is low enough to be outgrown. Unfortunately, the LaserPro Express has no memory expansion option.

The Oasys LaserPro Express is a solid value but not something to get excited about. On the one hand, it offers a range of emulations and other useful features. On the other, it has a limited memory and can potentially suffer print quality problems from the exposed drum. But if you're in the market for a low-cost laser printer that can emulate the HP LaserJet and other industry standards, the price and performance of the LaserPro Express are right.—**M. David Stone**

[illegible]

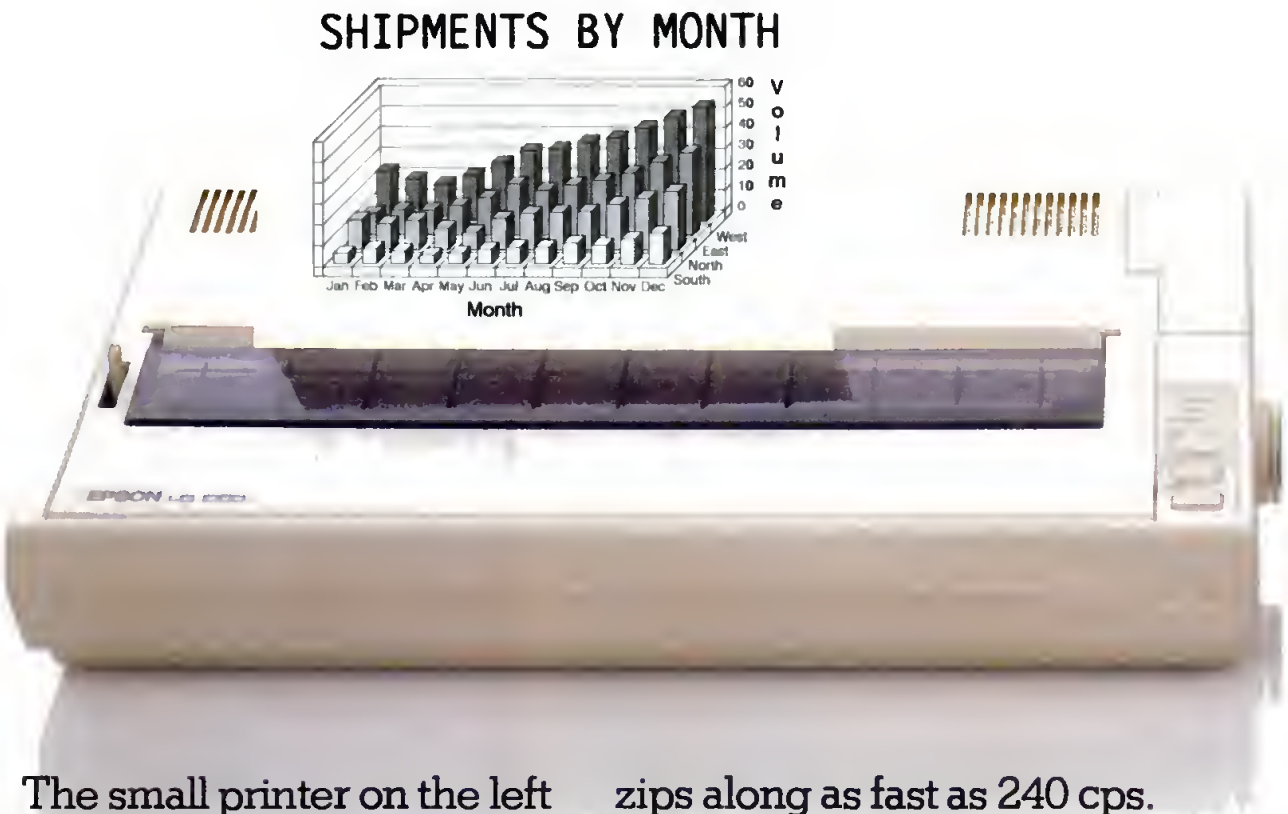
The $2,295 Oasys LaserPro Express Series II, from Office Automation Systems, goes beyond standard emulations to offer users a vast number of user-controllable settings and a powerful proprietary command set.

To start with, the Express Series II comes with four resident emulation options. Like the lower-priced Oasys LaserPro Express, it offers one dot matrix (Epson FX-80) and two daisy wheel (Diablo 630 and NEC 3550) modes. The Laser Pro Express Series II adds HP LaserJet Plus emulation and can even accept HP font cartridges. I tested the Epson and HP LaserJet emulations and found mixed results.

Like many of the other page printers we tested, the Express Series II had difficulty with the PC Labs Epson FX-80 graphics test. The first page lost its heading text, and the top of the image was offset to the right. On subsequent pages, the initial portion of the heading text was cut off, although the graphic image was correctly reproduced. The graphics ran successfully under the MX-80 Graftrax version of the test, but on subsequent text pages the lines were compressed vertically. The printer did handle the text control commands properly under the Epson FX emulation mode.

During the HP LaserJet emulation tests, the printer handled the text and graphics commands correctly, but the graphics print quality left much to be desired. Although the toner distribution was quite even and there was little washout in areas of black, the definition of fine lines was disappointing: the pinstripes within the circle on the pattern were faint smudges compared with the output of some competing printers.

OTHERS PALE B



The small printer on the left seems positively unexciting next to the new ALPS ALQ300.

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first dot matrix printers with reso
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y're versatile. A full range of mod
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les, pitches and fonts.

The ALQ300 prints everything from the letter quality text you see here, to high resolution graphics in seven colors.

It's much easier to use, too. Because you do everything

Y COMPARISON.



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You may have also noticed that the ALQ300 looks more substantial. It is. Treat it right and it'll run over five years without a breakdown.

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Besides these standard emulations, the Express Series II offers some typical specifications. The print engine is rated at 8 ppm and managed 7.4 ppm in the PC Labs speed test. The printer comes with both parallel and serial ports, a 250-sheet paper tray and a manual feed slot, and facedown paper output (no straight-through paper path is available).

The printer's front control panel is typical of older designs: it has just a two-character LED display with five indicator lights and six buttons. Configuring the printer using these controls is complex and not intuitive, since you must deal with abstract codes. The task is made harder by the strange sequence of some of the settings. For example, the C2 and C3 settings control the selection of the current font by specifying the second and third pairs of digits in the font ID number, but the first pair is controlled by the C5 setting.

CLARIFYING THE COMPLEXITY

The Express Series II helps clarify the results of this confusing configuration process by printing out a detailed status sheet that can be used to determine which settings are currently in effect. The information really is detailed: it takes more than 30 lines of 16-pitch type in two columns to list it all, and that's before you get down to the list of available fonts. The Express Series II comes with 14 different resident fonts, plus 6 more on disk, along with some batch files to download them automatically. Many of the fonts are duplicates in type style and size, and differ only in the symbol set used for the high-order characters.

There are so many lines of information on the status sheet because the Express Series II offers an incredible range of settings that you can control. Besides such mundane details as top and left margins, page width and length, and characters per inch, you can also control esoteric details like form-feed, time-out, buffer-full percent, and something called the daisy reference point adjustment (measured in dots). This last item permits you to relocate the first print position so that it falls within the printable page area, but this takes effect only when one of the daisy wheel emulations is being used. The other settings give you control over parameters that most manufacturers simply set at the factory; this gives you the opportunity to fine-tune your applications.

In fact, Oasys went even further in its quest to design a customizable laser. The Express Series II also features a printer control language called the Express Command Language. The commands include graphics primitives, so that you can draw circles, boxes, lines, and other geometric shapes on the page. You can create shaded boxes and customize fill patterns. There are even facilities that let you draw bar codes in 39 different formats.

Another interesting feature is the machine's ability to create new fonts using the GENF command. The Express Series II includes a series of type-style definitions that can be used to create fonts of different weight, orientation, height, width, and degree of angle. The typefaces include shapes that are similar to Helvetica, Times Roman, Optima, and Gothic. Fonts generated with this command become available in the printer just as if they were downloaded from a disk.

However, all this power is difficult to access owing to the quality of the printer's documentation. The organization of the material is haphazard, indexing is nonexistent, and the writing style is less than lucid. In some cases, the writing is so stilted that it is actually amusing.

The manuals are filled with contradictions, repeated information, and garbled instructions. In some places, what the manuals don't say is almost more important than what they do say. For example, under the HP LaserJet Plus emulation section, only passing reference is made to the hierarchy of font selection commands, and four HP commands that are not supported by the printer are listed. Fortunately, an Oasys representative reports that the manuals are being revised.

The LaserPro Express Series II is priced aggressively at only $2,295 and has some interesting features, but these are somewhat obscure and difficult to access. The machine is most likely to appeal to developers seeking a powerful printer that can be tightly linked to custom applications. As for the average person seeking a printer to use with general-purpose applications, other printers will probably have greater appeal.—**Alfred Poor**

PC MAGAZINE FACT FILE



Oasys LaserPro Express Series II
Office Automation Systems Inc.
8352 Clairemont Mesa Blvd.
San Diego, CA 92111
(800) 732-4589
(800) 732-4588 (in Calif.)
List Price: $2,295
Dimensions (HWD): 12 × 20 × 16 in.
Weight: 50.6 lbs.
In Short: This versatile 7.4-ppm machine has a wide range of customizable features and a powerful proprietary command set, but its lack of print quality for HP LaserJet Plus graphics, poor documentation, and obtuse front-panel controls diminish its appeal.

CIRCLE 620 ON READER SERVICE CARD

Oasys LaserPro Silver Express

The $2,795 Oasys LaserPro Silver Express, from Office Automation Systems, is big brother to the $1,895 Oasys LaserPro Express (also reviewed in this issue). In fact, the two printers are nearly identical, but Oasys has given the LaserPro Silver Express some important enhancements not shared by its sibling.

The LaserPro Silver Express adds Qume Sprint 11 emulation to the LaserPro Express's emulations of the IBM Proprinter, the Epson FX-80, the Diablo 630, and the NEC 3550, and it substitutes HP LaserJet Plus emulation for the LaserPro Express's HP LaserJet emulation.

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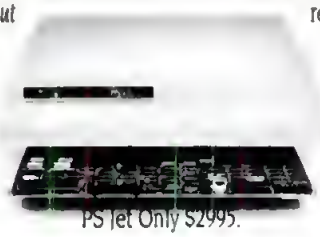


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CIRCLE 186 ON READER SERVICE CARD

press are the same as those in the LaserPro Express: Courier, Elite, and Vetica (a Helvetica look-alike). However, the Silver Express includes 13 additional downloadable fonts that come standard on-disk—7 more than the LaserPro Express offers.

As with the LaserPro Express, other downloadable fonts are available on-disk, and you can outfit the LaserPro Silver Express with an option that will enable it to accept HP font cartridges. The font cartridge option is $200 by itself, $500 in combination with a memory upgrade to 1.2 megabytes. The base memory on the LaserPro Silver Express is 768K, whereas it's only 512K in the LaserPro Express.

The LaserPro Silver Express uses the same engine as the LaserPro Express. Designed by Oasys and built by Tokyo Electric Co., the engine uses a separate drum unit and developing unit. To set up the printer, you hook the two units together and place them in the printer.

Not surprisingly, the operator's manual for the LaserPro Silver Express suffers from the same problems that mar the LaserPro Express manual. Although the manual gives useful information about operating the printer, its installation instructions are confusing. Worse, the manual omits such basics as instructions for wiring a cable for the serial connector.

Oasys is aware of the shortcomings in the manual and is currently rewriting it. If you buy the printer, be sure to get a new manual when it becomes available.

The Express command language is the native set of commands for the LaserPro Express and Silver Express printers. The version used in the LaserPro Express will let you change fonts, set character spacing, control print enhancements, select orientation, and otherwise control the printer. The version that the LaserPro Silver Express uses adds graphics primitives and the ability to generate bar codes and fonts.

GRAPHICS AND FONTS The graphics primitives include boxes, circles, arcs, and fills. You can use them to design business graphics or shade areas of a page. According to Oasys, value-added resellers (VARs) and original equipment manufacturers (OEMs) are the main customers for the graphics primitives, using them to add functionality to their own software packages. If you're buying the printer for your own use, however, you'll have to program the printer before you can use this aspect of the Express language, or you'll need software that already knows how to use it. As of this writing, no off-the-shelf software takes advantage of the Express command language, but, according to Oasys, several software houses are currently working on it, including Microsoft, MicroPro, and Ashton-Tate.

The LaserPro Silver Express also has a font generation feature called the Pyramid Font System. It stores the pyramid fonts in memory as mathematical representations of various font styles. Oasys describes these font styles as being "like Helvetica, like Times Roman, like Gothic, and like Optima."

For each of these fonts, you can define character height (up to 210 dots at 300 dots per inch), degree of slant for italics (up to 45 degrees forward or backward), rotation (portrait, landscape, inverted landscape, or inverted portrait), amount of boldfacing in both horizontal and vertical directions, and the number of characters in the character set. Once you've defined a font, the printer will build a bit-mapped image of it and store it in RAM. The font will disappear from memory each time you turn off the printer, but if you store the appropriate command in a file, you can recreate the font easily enough whenever you need it.

Each command in the Express language starts with the sequence: left parenthesis, O, right bracket; "O". Since the commands are so distinctive, the printer won't confuse them with any of the Escape commands in the emulation modes and can therefore respond to them no matter what emulation mode it's using. This design makes using the Express command language features easy at any time.

FINE DIFFERENCES On the outside the LaserPro Silver Express is physically identical to the LaserPro Express, except for the word *Silver* on its nameplate. It looks like nothing so much as a shortened designer cube. As with the LaserPro Express, the paper tray is flush with the front of the printer, and the exit tray is a molded depression in the top of the printer. Paper comes out facedown, automatically collated. The front panel includes six touch-sensitive switches and several error lights.

The LaserPro Silver Express, like its little brother, the LaserPro Express, stores its settings in nonvolatile memory rather than using DIP switches. Whenever you turn the printer on or press the test button, the LaserPro Silver Express prints the current settings in a status sheet, detailing such information as interface setting, printer emulation, and current font.

The small LED alphanumeric display shows the same arcane setting codes as the display on the LaserPro Express shows. The printer emulation setting is P1, the interface type setting is P4, and so on. As with the LaserPro Express, you can change the settings through the front panel by hitting various buttons and reading the codes. But unless you have an unusually good memory, you'll need the status sheet,

PC MAGAZINE FACT FILE



Oasys LaserPro Silver Express
Office Automation Systems Inc.
8352 Clairemont Mesa Blvd.
San Diego, CA 92111
(800) 732-4589
(800) 732-4588 (in Calif.)
List Price: $2,795
Dimensions (HWD): 12.5 × 16 × 16.5 in.
Weight: 50.6 lbs.
In Short: This 7.4-ppm laser printer, based on a Tokyo Electric Co. engine, offers good quality output, a double handful of printer emulations, 16 fonts as standard, and built-in font generation and graphics primitives. However, the price puts it into fiercely competitive territory.

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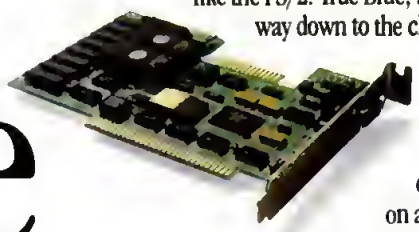
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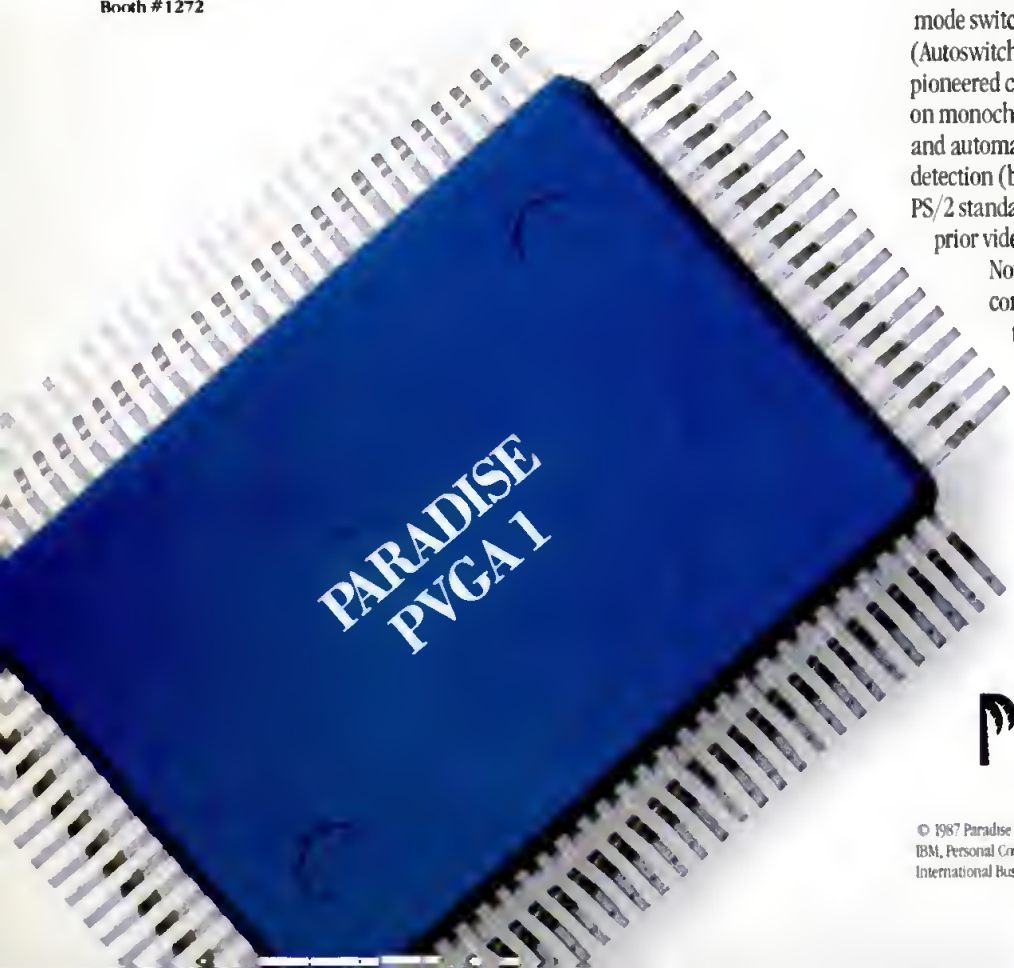
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the manual, or both to keep track of the various codes. The procedure is simple enough but clumsy, requiring you to look up too much information.

As you would expect from two printers using the same engine, speed and print quality on the LaserPro Express and the Silver Express are identical. The LaserPro Silver Express is rated at the same 8 pages per minute as the Express, and it scored the same 7.4 ppm on the PC Labs speed test. Text and graphics output is suitably dark and looks like it came from a good copier, as is typical of laser printers.

On the Epson emulation in the PC Labs graphics test, the LaserPro Silver Express also performed identically to the Express. In both cases the Epson FX-80 graphics emulation mode worked with PC Labs MX-80 graphics, not with FX-80 graphics. This small discrepancy is important to keep in mind when installing software for the printer. The printer had no problem with HP LaserJet Plus graphics emulation.

The Oasys LaserPro Silver Express offers a range of emulations, including HP LaserJet Plus, and a choice of fonts. Like its little brother, it's a solid value. But its $2,795 price tag puts it in competition with a good number of heavyweights in the laser arena. Stacked up against some of these machines, the LaserPro Silver Express is not a printer you'll get excited about—unless you plan to use the Express command language in your own software.

—M. David Stone

Okidata Laserline 6

The Okidata Laserline 6 is a nice deal. For $1,995 (the cost of the basic laser printer plus a personality module), you get Hewlett-Packard LaserJet Plus compatibility with more built-in fonts than the HP LaserJet—14-point Helvetica, 12-point Courier, 10-point Times Roman, 8-point Times Roman, and Line Printer. If you need more, the 5.8-page-per-minute Laserline 6 can accept HP LaserJet font cartridges or Okidata's own. The built-in fonts are satisfactory in appearance, and the print is solid and black.

A setup guide provided with the Laserline 6 uses clear photographs—not confusing diagrams—to lead you through the installation. That process takes a while but is somehow fun, requiring you to push various levers and even use a rachet crank to extract the foil covering from underneath the toner cartridge.

The paper tray extends from the right-hand side of the printer, and paper is collected in a well on the top. The input and output trays are both rated for 150 sheets, which is a little on the light side compared with trays that can easily hold up to 250 sheets. A manual paper-feed is also included.

A $200 personality module is necessary for using the Laserline 6 printer. This personality module is a small unit that slides into the back of the printer and defines the emulation capabilities and the interface. I tested the personality module with HP LaserJet Plus emulation (the only emulation currently available) and a parallel port. A personality module with a serial port is also available.

The personality module comes with a handbook that describes the use of the HP LaserJet control sequences and contains instructions on installing some popular programs (*WordStar 2000*, *1-2-3*, *Microsoft Word*, and *WordPerfect*) for use with the Laserline 6. The manual is very good and even includes an example of programming graphics in BASIC.

Also included with the personality module is a disk of *LaserControl* software (a repackaged version of *LaserControl 100* from Insight Development Corp.) and another excellent manual. Using a full-screen display with a menu from which you can configure the Okidata Laserline 6, this software provides emulation of the Diablo 630, NEC 3550, Qume Sprint 5, Epson MX-80, and the IBM Graphics Printer. Two versions of the program are supplied: one is run from the DOS command level whenever you need it, and the other remains resident.

Whichever version you run, the emulation software remains resident and translates control sequences associated with these other printers into HP LaserJet Plus control sequences. This emulation helps out in a pinch, but you get much better results using the printer as a LaserJet compatible, particularly for graphics. For example, the manual warns about losing the first couple of characters on each line because the emulation software attempts to start at the left edge of the paper. This is a nuisance. I would have preferred that the emulation software compensate for this problem.

I also looked at Okidata's multiuser personality module. Costing $400 more than the standard Laserline 6 personality module but allowing three adjacent PCs to be attached to one printer, this module electronically switches among the three printer ports and prevents the dangerous surges that might be a problem with mechanical switches. If data is coming through one of the ports, the module creates a not-ready status on the other two ports. Only if data ceases to come through a port for 15 seconds will the other two ports again be polled for data.

The multiuser personality module comes with three copies of the printer handbook and three *LaserControl* software packages. The *LaserControl* disk would be an excellent place for Okidata to include a software print buffer.

As a printer-sharing device, the mul-

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Okidata Laserline 6
Okidata Corp.
532 Fellowship Rd
Mount Laurel, NJ 08054
(800) 654-3282
List Price: $1,995, including personality module. $400 for multiuser personality module.
Dimensions (HWD): 16.5 × 16.1 × 8.2 in.
Weight: 37.8 lbs.
In Short: Extra little touches—like clearly written user manuals, numerous built-in fonts, and easy-to-use configuration software—make this 5.8-ppm laser printer a good package at a great price.

CIRCLE 654 ON READER SERVICE CARD

tiuser personality module can be a real cost-saver—but don't expect miracles from it. There is no buffering of printer output within the module. If one PC is engaged in a lengthy print job and another PC tries to print, the second PC must wait for the printer to become free. How an applications program handles this situation can vary. Some programs may hang until the printer port becomes available; others may prematurely terminate.

If you install the multiuser personality module, you might want to also install a software print buffer in each of the three machines. That would at least give the appearance of concurrent printer use.

Overall, with the Okidata Laserline 6 is a good package at a great price. It's the extra little touches—the additional built-in fonts, the manuals, and the configuration software—that make the big difference. And with the multiuser personality module, you get a laser printer that costs less than $800 (list price) per user. There's real value here.—**Charles Petzold**

Personal Computer

Personal Computer Products' LaserImage 2000 is a $3,495 machine that likes to do things its way. Going it alone, the Ricoh-LP4081-engine laser printer packs a few surprises—some pleasing, some of doubtful value, and some less than pleasing.

When it comes to emulating other printers, the LaserImage 2000 follows a largely untraveled route. In native mode, it emulates the popular Diablo 630 daisy wheel printer, offering four built-in fonts: 12-point Courier, 8.6-point Helios, 12-point Prestige Elite, and 12-point Helvetica, all monospaced except for the proportional Helvetica. [*After this review was written, the LaserImage 2000 was upgraded. It no longer has only four resident fonts. Instead, it now features the same seven resident fonts as the LaserImage 3000: 10-point Courier, 14-point Helvetica Bold, 8-point Times Roman, 10-point Times Roman, 10-point Times Roman Bold, 10-point Times Roman Italic, and 16-point Line Printer. Our evaluation is based on the unit we saw, not the one that is presently being shipped.—Ed.*] Built-in Hewlett-Packard 7470 plotter emulation allows you to take limited advantage of HP Graphics Language mode, which is the preferred language in large HP and IBM plotters. An additional $225 buys you a font cartridge that enables the printer to emulate the full HPGL plotter language.

EMULATION PROBLEMS Whereas Diablo and HP 7470 emulation modes are resident in the LaserImage 2000, Epson MX-80 emulation is achieved by downloading a file from the printer's utilities disk. And by purchasing two optional plug-in font cartridges for an additional $500, you can get the LaserImage 2000 to emulate the Hewlett-Packard LaserJet Plus. But unfortunately, neither the downloaded nor the cartridge-supplied emulations are 100 percent Epson or Hewlett-Packard compatible.

If you want a Diablo-630-emulating laser, fine, but if your software requires Epson or HP emulation, be ready for some problems. The first is that Epson emulation is not resident. The second is that the 1.5-megabyte model of the printer can hold only about 10 downloaded fonts in memory at one time.

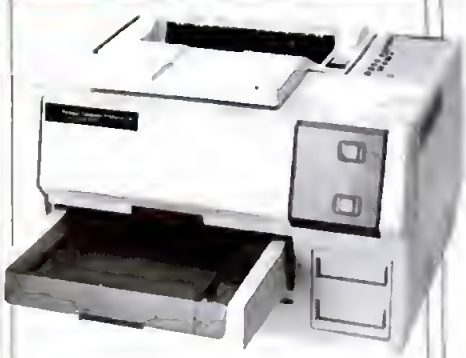
The third problem is that what you request is not always what you get. During the PC Labs graphics test, for example, Epson emulation put text and graphics on separate pages rather than on one page. Also, during the PC Labs fonts and features test, the printer neither repressed near-letter-quality and draft control codes nor fully implemented them. It accepted the <Esc> x part of the control code sequence but printed the switch character (1 or 0). Furthermore, high-order characters in Epson emulation are not the italic you'd expect to find, but rather the standard IBM high-order character set—almost. Somewhere in the middle of the code group, the LaserImage 2000 interprets a high-order character as a form-feed.

The HP LaserJet Plus emulation is as bland as in an actual LaserJet. There are no underlining, italic, or boldface enhancements, as well as no subscripts or superscripts unless you buy the entire optional package, which includes the emulated HP "B" font cartridge as well as the standard HP Courier-only "A" cartridge.

The PC Labs speed test turned up some surprising results. Run in native Diablo mode, the printer performed at a respectable 7.5 pages per minute as opposed to its 8-ppm rating. But in the cartridge-based HP emulation, the printer dragged along at 4 ppm.

Personal Computer Products identified the cause. The LaserImage 2000 has both a full bit-image and a partial bit-image mode. Under full bit-mapped operation, the printer waits to receive an entire page before it prints that page and ejects the sheet. This method slows the printer when it's working from a cartridge, says a company representative. In partial mode, the LaserImage 2000 prints as the information is received. With a DIP switch set for partial mode, HP emulation gained back lost time and settled in at 7.5 ppm.

PC MAGAZINE FACT FILE



Personal Computer Products
LaserImage 2000
Personal Computer Products Inc.
11590 W. Bernardo Ct., #100
San Diego, CA 92127
(800) 225-4098
(800) 262-0522 (in Calif.)
(619) 485-8411
List Price: $3,495
Dimensions (HWD): 14.5 × 20.9 × 23.2 in.
Weight: 81.6 lbs.
In Short: A competitively priced 7.5-ppm laser printer; imperfect emulations of the Epson MX-80 printer and the Hewlett-Packard LaserJet Plus detract from the printer's 250-sheet capacity, easy paper-loading method, and collating service.

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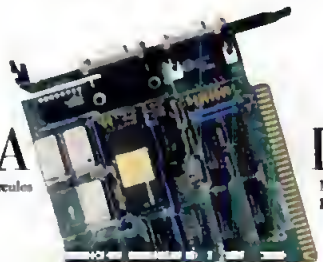
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Another reason to approach the LaserImage 2000 with knowledge aforethought is the pull-out drawer design of its Ricoh print engine. Although it's not difficult to insert toner and drum into the pull-out drawer, all it takes is a tug in the wrong place at the right time for loose toner to end up on the floor.

> The LaserImage 2000 follows a largely untraveled route: in native mode, it emulates the Diablo 630 daisy wheel printer, offering four built-in fonts.

DESIGN PLUSES Yet one of the LaserImage 2000's more pleasant surprises is related to the design of its print engine. Since it's a Ricoh-engine printer, it ejects printed sheets of paper from the top of the machine, where they rest in the paper stacker. More unusual than the fact that the paper stacker is on the top of the machine rather than on the side of the printer (standard for a Ricoh engine) is that the ejected pages are collated. Especially when you're working with long documents, having the printer do the collating for you is a real timesaver.

The LaserImage 2000's indicator panel is also worth noting. If you crave technical feedback, you'll appreciate the LaserImage 2000's panel. Its 13 buttons and lights allow you to select the emulation mode and whether to print in portrait or landscape format. In addition, they indicate such conditions as power-on, printer ready, and printer on-line. The panel also alerts you when to add paper, change the toner cartridge, replace the toner collector, correct a paper jam, or call your supplier or field service engineer. It displays error codes when RAM, timer, serial I/O, and CPU bus errors have occurred, as well as when the cover or drawer is open and when paper has been misfed in either the eject or the feed unit.

A guide laminated to the top of the printer makes it easier for you to interpret the symbols on the panel. The company's evident interest in keeping you informed is also reflected in the manual, which gives clear directions for setting up the printer in its Diablo native mode and using it with *Microsoft Word*, *MultiMate*, *WordStar*, *1-2-3*, and *SuperCalc3*. And although the vendor tells you that you'll need to get hold of the HP LaserJet Plus Technical Reference Manual for a detailed explanation of the HP control codes, Personal Computer Products does give you a brief user manual with the HP emulation cartridge that lists the codes. Unfortunately, the user manual does not tell you which HP codes the printer does not support.

At $3,995 with the addition of the two HP cartridges, the LaserImage 2000 is certainly competitive with other non-PostScript laser printers. The 250-sheet paper capacity of the Ricoh engine and the collated sheets are certainly surprising pluses. But such rough edges as the imperfect emulations, the speed penalty for full bit-mapped printing in HP emulation, the missing guide rails in the cartridge slots, and the sticky toner drawer prove that surprises are not always pleasant.—**Carol Olsen Day**

Personal Computer Products LaserImage 3000

Personal Computer Products' LaserImage 3000 has one feature that requires you to take this Ricoh-engine printer seriously: its $6,395 price tag. What you get for your dollars is a printer with two slots for font cartridges, two paper cassettes, four emulations, 1.5 megabytes of memory (expandable to 2), and serial and parallel interfaces. What you don't get is adequate documentation and technical support.

Because the LaserImage 3000 is based on the first-generation Ricoh engine, installation is not as clean and simple as you would like. True, the parallel interface simplifies much of the process, but the need to shake the loose toner into the toner hopper negates that convenience. Also, if the top paper tray is not in place when you replace the toner, you may find your dry cleaning bills quickly approaching the printer's price.

The two paper cassettes sport lids that enable you to insert and remove paper without having to take the trays from the printer. This small but important improvement over the HP LaserJet's traditional cassette design simplifies paper replacement and letterhead swapping. Each cassette can hold 250 sheets of letter-, legal-, or A4-sized paper. You can set the printer so that a run can feed all 500 sheets continuously.

Another handy feature is the paper path. The output comes out facedown and automatically collated.

The printer's front control panel has a mixture of buttons, LEDs, and a 16-character LCD. The various switches control font and cassette tray selection as well as form-feeding. Unlike the two-character LEDs found in the HP LaserJet printers, other Ricoh-based laser printers, and a large majority of the lasers on the market, the LaserImage 3000's LCD messages offer some relief to the literate. We say "some" because many of the standard messages, such as those for on-line and off-line status, are still displayed with LED icons that require a degree in cryptography to decipher.

Also, the LCD itself is underutilized, displaying only a RAM check message, the current emulation, and the available fonts. Given the cost of the machine, a little more effort could have been expended to include more messages and display features.

The LaserImage 3000 comes with four emulations: built-in LaserJet 500 Plus, downloadable Epson FX-80 and Diablo 630, and an HPGL-7470 cartridge. The Epson emulation is acceptable, about on a par with comparable emulations on other laser printers.

Standard fonts include Courier, Helvetica Bold, four Times Roman fonts and a 16.6-pitch Line Printer font. You access the fonts through the front control panel or through software escape-code sequences. The characters themselves are clean and highly legible.

Most of the unsupported escape-code sequences are those specific to the dot-matrix world, such as printhead and ribbon commands. While you may not expect a

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- *2, 4 or 6 input ports*
- *Serial or parallel output*
- *0Kb to 1MB of RAM— often soldered, not adaptable for memory expansion*
- *Sequential scanning or concurrent input*
- *Warranty— 90 days to one year*
- *Compatible with most printers*



- *Up to eight serial input ports*
- *Serial and parallel outputs*
- *Concurrent input and output for all ports*
- *Easy, menu-driven configuration*
- *Separate baud rate, flow control, parity and messages for each port*
- *Multiple copy command*
- *Priority print command*
- *User-definable print direction*
- *Field expandable memory up to 2MB*
- *Printer emulation codes and prompt/response messages stored in RAM*
- *Automatic top-of-form generation*
- *Self-testing features*
- *Buffer clear, pause and top-of-form controls*
- *LEDs display buffer status, current port activity and printer ready*
- *Optional parallel/serial converter*
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- *Quality and reliability backed by a one-year warranty; lifetime warranty optional*
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- *UL approved*



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CIRCLE 503 ON READER SERVICE CARD

laser printer to include such commands, you would expect it to trap the ones it does not support. Unfortunately, the LaserImage 3000 has poor-to-negligible error trapping. For example, rather than trap the Epson FX NLQ code sequence—an unnecessary and perhaps redundant command to laser printers—it allows the code to pass through and print out on the document.

PC Labs benchmark tests show that whether in software or hardware emulation mode, the LaserImage 3000 puts out a consistent 7.3 pages per minute (in contrast to the factory-rated 15 ppm). A possible explanation is that the printer is set for full bit-mapped graphics, which generally cuts text throughput in half, especially when a printer is printing in HP LaserJet emulation. However, the printer's Epson-emulation throughput came in with the same rating.

While the LaserImage 3000 is a serviceable printer, it does not offer enough for its price. At the very least, it should come with complete documentation. A vendor who refers a customer to Hewlett-Packard for documentation should also refer the prospective buyer to HP for a printer. For that matter, the technical support is also not even up to par.

Although the LaserImage 3000 is a possible alternative to the HP LaserJet 500 Plus, you might be better served by buying two of the new HP LaserJets, or a QMS Kiss and a Brother International Twinriter 6. In fact, for $6,495, you might be able to buy all four.—**Vincent Puglia**

PC MAGAZINE FACT FILE



Personal Computer Products LaserImage 3000
Personal Computer Products Inc.
11590 W. Bernardo Ct., #100
San Diego, CA 92127
(800) 225-4098
(800) 262-0522 (in Calif.)
(619) 485-8411
List Price: $6,395
Dimensions (HWD): 16 × 21.5 × 18.5 in.
Weight: 90 lbs.
In Short: Based on the first-generation Ricoh engine, this 7.3-ppm alternative to the HP LaserJet 500 Plus also offers downloadable Epson FX and Diablo 630 emulations. However, insufficient documentation and poor error trapping reduce its value (but, unfortunately, not its high price).
CIRCLE **624** ON READER SERVICE CARD

Printronix L1012

It may not be flashy, but the $3,495 Printronix L1012, from Printronix, is one of the fastest printers in its price range. Rated at 12 pages per minute, the L1012 came just short of breaking the 10-ppm barrier in the PC Labs speed tests. At least 2 ppm faster than most lower-priced machines, the Printronix L1012 is also faster than quite a few printers that cost more.

Resembling an office copier, the Printronix L1012 is equipped with a heavy-duty Mita print engine. Installation takes some time, since you must cope with a bewildering assortment of covers, spacers, and other protective gear that come bolted, taped, and otherwise attached to the consumable components. Once assembled, however, the machine appears set for a long and productive life.

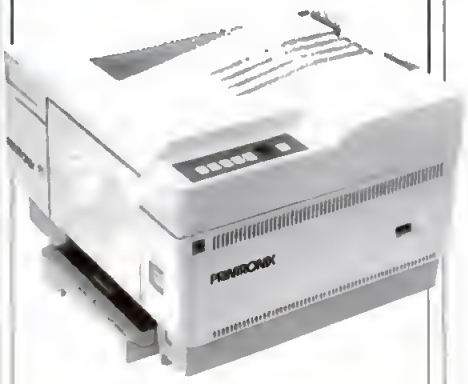
Besides Courier, Courier Italic, Line Printer, Prestige, Prestige Elite Italic, and Roman fonts, the Printronix L1012 offers two Optical Character Recognition (OCR) fonts: OCR-A and OCR-B. All fonts can be made bold by the controller on demand, and all can be printed in either portrait or landscape orientation.

Aside from its speed and extra fonts, the L1012's specifications are fairly typical. It comes with either a parallel or serial interface (we tested the parallel version), a 250-sheet paper tray, a manual feed option, and a choice of faceup or facedown output. The paper path is slightly unusual in that the manual feed to faceup follows a straight-through path, while the route to facedown is S-shaped.

The L1012 has standard emulations. It accepts commands for the Diablo 630 daisy wheel, the Epson FX-80 dot matrix, and the Hewlett-Packard LaserJet Plus laser printer. I tested the Epson FX-80 and HP LaserJet emulations and found that they worked well. Like many other laser printers that emulate the FX series, the Printronix L1012 did not print the page heading and the graphics on the same page. But it did print the graphics sample properly under the Epson MX version of the PC Labs test. The L1012 was also able to generate expanded characters when in the Epson mode.

The Printronix L1012 has a few drawbacks. Although the printer has font car-

PC MAGAZINE FACT FILE



Printronix L1012
Printronix
P.O. Box 19559
Irvine, CA 92713
(714) 863-1900
List Price: $3,495
Dimensions (HWD): 12.5 × 18.9 × 17.3 in.
Weight: 66 lbs.
In Short: Fast (9.9 ppm), solidly built, and with a useful complement of resident fonts, the Printronix L1012 has some attractive features. But its midrange price and its design flaws detract from its appeal and limit its overall value.
CIRCLE **547** ON READER SERVICE CARD



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The 136-column carriage gives you all the space you need for printing spreadsheets. An automatic Sheet Load and Push Feed Tractor facilitate paper handling; while an 8K internal buffer holds and prints data so you can use your computer at the same time.

Even add impact to graphics and charts with the user-installable Color Option Kit. And further expand your image processing capabilities by adding the image Scanner Option Kit. It will read virtually any hard copy image, store it in your computer's memory, and allow you to integrate it with your printing output.

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tridge slots, the feature has not yet been implemented and none are available. The second problem is print quality. The black areas were solid with almost no toner washout, but the bottom edges of some of the black bars were not sharp. On the HP LaserJet emulation test, the fine detail on the graphics faded almost to gray.

The L1012's documentation contains detailed descriptions of all the commands in all three emulation modes, but the information is organized in a peculiar manner. Each command has a descriptive name and is listed on a separate page. These pages are arranged in alphabetical order by the command name, as opposed to grouping them by logical functions. To find out how to switch from portrait mode to landscape mode under HP LaserJet emulation, for example, you must first research the command list to find that the command is called Print Orientation before you can look it up.

Other problems arise from the design of the printer. The cryptic two-character display is outdated, and the front control panel cannot be used to configure all the printer's features. This is a problem if you have a serial port version of the printer. Should you need to make a change to the factory settings for bps rate or other serial communications parameters, you must open the printer and extract the controller card to reach the DIP switches. This strikes me as a needlessly complex and difficult procedure, especially when other machines let you change these settings through the front-panel controls.

> The Printronix L1012's high price is offset somewhat by its speed, rugged design, and complement of resident fonts.

At $3,495, the Printronix L1012 is expensive for a single-user printer. Its high price is offset somewhat by its speed, rugged design, and complement of resident fonts, but those features must be weighed against its fair print quality. If you need a printer with OCR fonts or are looking for a laser that will be shared among multiple users, the Printronix L1012 is worth a look. But there are alternatives that offer better value.—**Alfred Poor**

Printware 720 IQ Laser Imager with 1200HD Image Processor

You may not think of the $12,980 Printware 720 IQ Laser Imager with 1200HD Image Processor (a unit that can store fonts and images) as being an inexpensive package, but it is when you compare it with other high-end machines. Based on low-cost laser technology originally developed at and licensed from 3M, this 1,200- by 600-dot-per-inch, 6.7-page-per-minute laser printer cuts corners on cosmetics without compromising quality. The result: an affordable high-resolution office printer whose output challenges that of $30,000 typesetting machines.

More expensive by $4,000 than the Kyocera F-3010, a 300-dpi laser printer with a measured speed of 15.6 ppm, the Printware 720 has different priorities from its speedy competitor. While Kyocera has doubled and tripled the existing standards for speed, Printware has multiplied by eight the 300-dpi standard for resolution. An increase from 300 by 300 dpi to 1,200 by 600 dpi translates into a difference of 90,000 versus 720,000 dots per square inch. Hence at almost $6,000 less than one of its closest high-resolution competitors, the 600- by 600-dpi Varityper VT-600, the Printware 720 IQ Laser Imager and controller offers double the resolution. But this is not the best of all possible worlds, and you do have to give up some things for this lower price.

Although Printware's own page description language is fully featured and impressive, the unit we reviewed did not support the Hewlett-Packard and PostScript standards. According to the vendor, Printware will support PostScript through an emulation rather than license PostScript itself from Adobe. Although this will not necessarily present any problems when using PostScript-compatible software, the potential of incompatibility is slightly troubling.

The Printware 720 also lacks styling. While the 12.5- by 18- by 19.5-inch printer is housed in the casing of a Toshiba copier and uses an improved version of the Toshiba's paper transport system, its 6.75- by 21.25- by 16.5-inch controller sits in an AT clone box. To conserve space, stack the printer on top of the controller.

Printware chose the Toshiba copier shell because of its straight-through paper path system—a feature that helps reliability and output quality, according to a vendor representative. Printware replaced many of the Toshiba paper-handling mechanism's plastic parts with metal ones, as well as replacing virtually everything

PC MAGAZINE FACT FILE



Printware 720 IQ Laser Imager with 1200HD Image Processor
Printware Inc
1385 Mendota Heights Rd.
St. Paul, MN 55120
(800) 456-1400
(612) 456-1400
List Price: 720 IQ, $9,990; 1200HD, $2,990; total, $12,980
Dimensions (HWD): 720 IQ, 12.5 × 18 × 19.5 in.; 1200HD, 6.75 × 21 25 × 16.5.
Weight: 720 IQ, 80 lbs.; 1200HD, 28 lbs.
In Short: Challenging $30,000 typesetting machines, this impressive package uses a proprietary 6.7-ppm engine to produce razor-sharp 1,200- by 600-dpi output, but for now lacks HP and PostScript compatibility.

CIRCLE 549 ON READER SERVICE CARD

else. The printer's single-sheet paper tray holds 250 sheets, and you can get an optional 50-sheet bin ($300) to handle a less-used choice, such as legal-sized paper or letterhead. All jobs are manipulated in memory at the 1200HD Image Processor, then sent to the printer in reverse order, resulting in faceup collated documents.

With a measured speed of 6.7 ppm, the Printware 720 comes with Courier, Line Printer, and a symbol set in normal weight, Helvetica and Times Roman in normal and bold, and Times Roman in italic. This relatively low number of typefaces is deceptive, though, because Printware's 1200HD Image Processor can build any point size between 1 and 255. It can also produce boldface type by any percentage and can tilt them to create a kind of fudged italic. Whether the HP emulation will be able to take advantage of the processor's abilities and pretend that all the font characteristics of the typefaces are available remains to be seen. It would certainly be a nice feature.

My only complaint about Printware's Imaging Command Language is that you must do a complete font call-out, including the cryptic BitStream typeface filename, every time you want to change anything, as when you add 5 percent emboldening.

The 1200HD Image Processor can also take an optional 20-megabyte hard disk. This can be used to store downloadable fonts and graphics images such as signatures, logos, and bar codes. The graphics images can be treated as fonts that are callable within a document. The Printware Imaging Command Language can be used to store and delete the downloaded fonts on the hard disk, making the process of downloading fonts a lot more tolerable.

The printer has two toner hoppers—one for black and the other for a second color, either red, blue, or brown. Although still a long way from being a color laser printer, the Printware 720 can suffice if your needs for color are limited to producing original color letterheads and adding color for emphasis. To get two colors on a page, a document must be passed through the printer twice.

At a resolution level as high as that of the Printware, the quality and particle size of the toner become important considerations. The unit I tested had standard Toshiba toner in it, but Printware says it is looking into finer grinds for future use. Even when using normal toner, I found that the printer was more sensitive to its environment than most other machines. High humidity resulted in dropouts and clumping, suggesting a return to the old days of printer rooms with controlled environments. The quality of the paper you use also has an impact on the resolution and accuracy of the printing, although you will still get a significant improvement over 300-dpi printers no matter what paper you choose.

Putting aside the sensitivity of the toner and the extra cost of high-quality paper, the output from this printer makes you want it. Every printout is just that much clearer. But it's only when you use test material to exaggerate the difference between this printer's output and that of lower-resolution printers that the point is driven home.
—Philip F. H. Rose

QMS PS-800 Plus

The versatile QMS PS-800 Plus gives you nearly twice the value for your money. In one $5,495 PostScript-plus laser printer, QMS offers what you'd otherwise have to spend about $10,000 for: an Apple LaserWriter Plus and a Hewlett-Packard LaserJet Plus. Instead, the QMS PS-800 Plus goes each one better and gives you the same double duty—at about half the combined price.

Proving that it's all in the ROM, QMS has taken an ordinary Canon engine, added 2 megabytes of RAM, and stirred in a couple of handfuls of instruction codes. The result is a laser printer that can switch among Apple LaserWriter Plus/PostScript, Hewlett-Packard LaserJet Plus, Diablo 630, and Hewlett-Packard Graphics Language emulations.

First and foremost, the QMS PS-800 Plus is a PostScript machine. Like Apple's LaserWriter Plus, it supports a 9-pin and a 25-pin serial channel. Your IBM PC can access the PS-800 Plus, as it can the Apple LaserWriter Plus, in PostScript batch mode from *Microsoft Windows*, *Microsoft Word*, Aldus's *PageMaker*, and any program that supports Adobe's PostScript programming language. A Macintosh or Apple IIGS (or a PC with an AppleTalk interface card) can use the 9-pin port under the PS-800 Plus's AppleTalk mode. And any serial device can use the Diablo 630 and the HP LaserJet Plus modes.

The display panel along the top front of the PS-800 Plus has three lights that give you a visual clue as to what's happening. The green light over the word "ready," the amber light over the words "active" and "paper out," and the second amber light over the words "paper jam" go on in different combinations to indicate various operating states. Because the activity of laser printing is so quiet, it's reassuring to see the quick flashes of amber light that tell you the PS-800 Plus is printing your file.

Unlike Apple printers, which give you a slotted-shaft switch sans knob to select emulations, the QMS printer has a binary coded decimal (BCD) thumbwheel switch for selecting modes. Located on the lower-

PC MAGAZINE FACT FILE



QMS PS-800 Plus
QMS Inc.
One Magnum Pass
Mobile, AL 36618
(205) 633-4300
List Price: $5,495
Dimensions (HWD): 11.4 × 35.8 × 18.7 in.
Weight: 72 lbs.
In Short: Designed for PostScript users, this versatile 6.1-ppm Canon-based laser printer can also switch among Apple LaserWriter Plus/PostScript, Hewlett-Packard LaserJet Plus, Diablo 630, and Hewlett-Packard Graphics Language emulations; it has the speed for printing good-looking spreadsheets, databases, and reports, as well as the finesse for tackling desktop publishing.
CIRCLE 692 ON READER SERVICE CARD

left-hand side of the printer next to the two serial ports, this easy-to-change switch has ten settings. You can use the standard transmission rate, parity, and protocol parameters assigned to each mode, or you can change them to match your system's requirements.

Transmission rate is no obstacle. One batch mode is hard wired for 1,200 bits per second through either the 9- or the 25-pin port. You can program a second batch mode for any transmission rate to a maximum of 19.2 kilobits per second with each of the two channels capable of operating at independent speeds. Within PostScript, the PS-800 Plus emulates an HP LaserJet Plus, an HP plotter, or a Diablo 630 through either of the two ports with equal programmability.

If your plans include desktop publishing, the PS-800 Plus has what it takes to produce good-looking output. You get a wide range of type styles and sizes, including various roman, italic, and bold fonts in the following typefaces: Courier, Times Roman, Helvetica, Helvetica Narrow, Avant Garde Book, Bookman, New Century Schoolbook, Palatino, and Zapf Chancery, as well as symbols and dingbats.

If your plans include desktop publishing, the PS-800 Plus can produce good-looking output. You get a wide range of type styles and sizes, including various roman, italic, and bold fonts.

The PS-800 Plus's wealth of emulations means some trade-offs. The PS-800 Plus is built on a Canon laser engine rated at 8 pages per minute. Running PostScript, the speed of the PS-800 Plus falls to 6.1 ppm. That's not QMS's fault, though, since PostScript slows the speeds of all printers that support it.

The problem of speed degradation also comes up in the emulation modes. An HP LaserJet Plus runs through the PC Labs speed test at 7.5 ppm, while the emulated HP LaserJet Plus on the QMS machine is about 1 ppm slower, even though it's running at 9,600 bps. Speed aside, the HP Graphics Language emulation had a problem with the PC Labs emulation file. With the exception of the white square, the Benday scale was filled in with solid black rather than the appropriate patterns.

DISAPPOINTING DOCUMENTATION

Since the PS-800 Plus manual must explain so many emulations, the fact that it's somewhat disappointing isn't too surprising. The manual is lucid about language details but sparse on cohesive descriptions of how to implement those procedures. The assumption seems to be that most users will be using the PostScript emulation, and QMS supplies two valuable supplements to its manual for those who want to explore the advanced features of PostScript: the *PostScript Language Tutorial and Cookbook* and the *PostScript Language Reference Manual*, both written by Adobe Systems (published by Addison-Wesley Publishing Co., 1986).

Unfortunately, though, QMS leaves you on your own to cast about for the correct feature control codes for the HP LaserJet Plus and the Diablo 630. The omission becomes irksome when the manual mentions a feature that you'd like to use but doesn't tell you what commands or methods to use to access it. For example, the manual tells you that the PostScript fonts are available when the printer is emulating the HP LaserJet Plus and that you can scale them to any size and print them in portrait or landscape mode (a feat not possible with the actual HP LaserJet Plus), but it simply refers you to the HP LaserJet Plus documentation for information about the LaserJet Plus commands. (In HP LaserJet Plus emulation, the PS-800 Plus accepts downloaded soft fonts, which are available for $199 from The Laser Connection, a wholly owned subsidiary of QMS.)

These minor annoyances aside, the QMS PS-800 Plus is a well-implemented, versatile laser printer that offers a significant cost savings over the combined purchase of the individual printers it emulates. It has the speed you need to handle *1-2-3* and *dBASE* printing, as well as the finesse you need to tackle desktop publishing.
—Carol Olsen Day

QMS [illegible] 80 Plus

QMS is nothing if not prolific in the laser printer field. First it gave us the PS-800 Plus, and then its subsidiary, The Laser Connection, brought us the Kiss, the Big Kiss II, the PS Jet and the PS Jet Plus. Now QMS has come out with the SmartWriter 80 Plus.

As the company's latest non-PostScript entry, the $4,595 QMS SmartWriter 80 Plus has the Canon engine of the other QMS printers and the indicator panel, or keypad, of the QMS Kiss—plus it emulates practically every printer except the Apple LaserWriter.

What distinguishes the SmartWriter 80 Plus from its predecessor, last year's

PC MAGAZINE FACT FILE



QMS SmartWriter 80 Plus
QMS Inc.
One Magnum Pass
Mobile, AL 36618
(205) 633-4300
List Price: $4,595
Dimensions (HWD): 11.5 × 24 × 18.7 in.
Weight: 55 lbs.
In Short: An easy-to-control 7.5-ppm Canon-engine laser printer that emulates the HP LaserJet Plus, the Diablo 630, either the IBM Proprinter or the Epson FX-80, the Qume Sprint, and ANSI X3.64; all it lacks is PostScript.

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SmartWriter 80, is that the newer version includes HP LaserJet Plus emulation and either IBM Proprinter or Epson FX-80 emulation, as well as Diablo 630, Qume Sprint, and ANSI X3.64 emulations.

The printer we tested came with Epson emulation, but if you want IBM Proprinter emulation instead, you can have the SmartWriter 80 Plus your way. The 16 built-in fonts include variations of Courier, Q-Format, Q-Roman Medium, Q-Roman Medium Italic, Hamilton Medium, Hamilton Medium Italic, Letter Gothic, Letter Gothic Italic, Prestige Elite, and Prestige Elite Italic. In both Proprinter and Epson modes, you also get compressed, elite, and pica fonts.

In addition, you can either download fonts through software or use font cartridges, which plug into a slot on the printer's front panel. The SmartWriter 80 Plus is compatible with the same soft fonts and font cartridges, supplied by The Laser Connection, that the Kiss printers use.

The SmartWriter 80 Plus prints a status summary sheet each time you turn it on. As complete a summary as you'd ever need, it tells you which fonts are available and indicates which ones you're set up to use. It also informs you how many bytes of the printer's 2.5 megabytes of RAM are available for downloading fonts and for the input buffer. The print mode, page orientation, paper size, and copy count are highlighted, and the page margins listed. The summary sheet also tells you the keyboard options you've enabled and the number of pages that the engine has printed to date.

Not only is it easy to find out which fonts, memory, and options are available, but it's also easy to set up and control the SmartWriter 80 Plus. You can configure it either through software or from the front panel, or through what QMS simply calls the keypad.

The keypad has four function keys, three printer setup keys, and a two-digit display window. The function keys are the on-line key, with an indicator light to tell you when the printer is on-line; the manual-feed key, with a light to indicate when manual-feed is in operation; the form-feed key, which causes the printer to eject a page; and the test key, which you use to print a sample page of each of the resident character sets.

You use the three printer setup keys to customize, or program, the printer's features. The keys are labeled group, option, and toggle. The group key controls the printer's main categories of features, and the option key enables features that are subcategories of these options. Each emulation has a list of feature groups that you can control with the group and option keys. For example, in Epson emulation, you can select eight options, including print mode, print quality, international character sets, carriage returns, zero style, and pica default font. You simply use the toggle key to select the options you indicate with the two other keys.

Besides each emulation mode group, there are other groups of features, all with options to toggle on or off. These include change current font, change default landscape font, change default portrait font, system functions, page settings, copy count (1–9), copy count (multiples of 10), margin settings, common interface options, serial interface options, parallel interface options, alignment margin settings, and factory options.

The display window's alphanumeric LEDs produce two-character status codes to tell you what group and option you're selecting. At first, you'll need to consult the manual before you can interpret the codes. But the manual offers a comprehensive translation table for the character codes, as well as intensive pictorial documentation on making changes from the front panel.

The SmartWriter 80 Plus prints well, too. Its solids could be darker, but that's a function of the original Canon engine. Print speed, 7.5 pages per minute, is what you'd expect for a non-PostScript, HP-emulating printer.

As far as price goes, the SmartWriter 80 Plus could be smarter, but it will save you money over an HP LaserJet Plus and give you more in return. And although the SmartWriter 80 Plus costs $600 more than the Personal Computer Products LaserImage 2000 (including that machine's optional HP cartridges), the SmartWriter 80 Plus has 16 built-in fonts compared with the LaserImage 2000's 4 built-in fonts. The SmartWriter 80 Plus's emulations also perform better than the imperfect ones in the LaserImage 2000.

With the emulations that it supports, its good performance on the PC Labs tests, its 2.5 megabytes of RAM, and the number of fonts that it makes available, the smart, easily programmable QMS SmartWriter 80 Plus fulfills the promise of its name.
—Carol Olsen Day

Quadlaser I

The Quadlaser I, from Quadram Corp., is an impressive laser printer. It is a heavy unit at more than 81 pounds, and it comes with almost 20 diskettes, so right off the bat it's a leader in weight and number of pieces to deal with. The reason for all the diskettes: the $3,795 Quadlaser I includes several printer emulations and many fonts, as if it wants to be everything for everyone. The biggest problem with trying to do it all in this case is that it gets confusing trying to decide which way to use the printer.

The Quadlaser I is rated at 8 pages per minute and comes pretty close to that rat-

PC MAGAZINE FACT FILE



Quadlaser I
Quadram Corp.
1 Quad Way
Norcross, GA 30093
(404) 923-6666
List Price: $3,795
Dimensions (HWD): 14.5 × 21 × 23.5 in.
Weight: 81.6 lbs
In Short: The 7.5-ppm Quadram Quadlaser I includes more than 100 fonts, three emulations, and speedy laser print. This machine costs a bit more than many competitors, but if you need the flexibility, it may be worth it.

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ing, clocking in at 7.5 ppm on our speed tests. Quadram clearly advises that it rates speed for original pages, not subsequent copies of the same page. Next year that may not be fast enough for an almost $4,000 printer, but this year 7.5 ppm is acceptable.

The Quadlaser I's print quality is what you would expect from a laser printer: it's very good, but it looks as if it came from a copier. That doesn't bother me, but some purists still balk at anything other than fully formed impact characters. If you like laser-quality print, then the Quadlaser I will suit you just fine.

Depending on how you look at it, the Quadlaser I comes with either very few fonts (actually only two) or an overwhelming number of them. The only fonts actually built into the machine are 10-pitch Courier normal and bold. However, the included HP LaserJet Plus emulation diskette has eight fonts, and the other 13 diskettes (yes, 13) include another 90 or more fonts. If that's not enough and you want to add IBM Proprinter emulation, that software is available free either by calling the company or by downloading from Quadram's electronic bulletin board.

The Quadlaser I's print quality is what you would expect from a laser printer: it's very good, but it looks as if it came from a copier.

In all, the Quadlaser I comes with software to emulate the Qume Sprint 5, Epson FX-80, and HP LaserJet Plus printers. With so many emulations and fonts available it can be pretty tough to decide which way to go. Here's a quick guide.

The Epson emulation works well as long as you don't need good proportional spacing and you don't need italics. The Quadlaser I can create italics in Epson mode, but only in a dot matrix version, which is pretty silly for a close-to-$4,000 printer.

If your world revolves around HP fonts, commands, and such, then go with the HP LaserJet Plus emulation. Quadram includes a program that will convert soft fonts for the HP so they work with this emulation on the Quadlaser I.

Of course, if you just want plain old Proprinter emulation, then get that free software.

Qume Sprint 5 fans will without doubt select that emulation for software using only Qume drivers.

The Quadlaser I is memory rich. It comes with 2 megabytes of memory, 1 megabyte of which is available for downloading. Depending on the emulations and fonts you select, you can download between 30 fonts and 60 fonts.

Switching between emulations is as easy as issuing the commands BAR 1e, BAR 2e, and BAR 3e to switch between Qume, Epson, and HP modes respectively. The catch is that the fonts and emulations have to be in the memory.

Unless you intend to let your printer run forever, you have to reload the emulations and fonts you want to use each day. The smart way to handle this is to write DOS batch files that do it all for you. While the Quadlaser I is great at giving you lots of room to work with, unfortunately you have to fill at least part of it before you can get much done.

The Quadlaser I uses a Ricoh engine. You have to put in both a developer unit that is good for about 10,000 copies and two toner cartridges that together last for 6,000 copies. Since the toner tray is an open system that can spill all over you and the inside of the printer, use caution in loading. Otherwise the installation is simple. Paper comes out upside down in proper collated order.

Be sure to have someone else there to help you lift the Quadlaser I out of the box. A printer that weighs 81 pounds doesn't take to being tossed around lightly, and people's backs don't like it either.

One of the nicer features of this machine is its test mode. Once you've downloaded all the fonts you want, you can take the printer off-line and push a test button that will give you a printout listing all of the resident fonts.

The main documentation is a slipcased manual with pretty good explanations of the Quadlaser I's features. I almost missed an extra bunch of stapled sheets that tell how to use the newer HP LaserJet Plus emulation; the version of the manual I received covers only the older HP LaserJet.

The main advantage of the Quadlaser I is its flexibility. If you need all of the fonts and emulations that come standard with this printer, then you will probably save money over having to buy all of the fonts and emulations separately. If, however, you use only a portion of the supplied software, you could very well be spending more than necessary for the performance delivered.—**Bruce Brown**

Qume LaserTENPlus

The $3,395 Qume LaserTENPlus is almost indistinguishable from the rest of the laser world—except for its accent colors. Somewhere deep within Qume's product design division, a frustrated watercolorist must lurk. How else do you account for the pastel-colored function buttons and levers on the gray Hitachi-engine printer? Aside from that slight aberration, the LaserTENPlus comes with user-installable emulation modules and three slots for optional font cartridges.

We evaluated the printer with the Three-In-One Emulator installed. This module lets it emulate the Epson FX-80, the IBM 5152 (the original IBM Graphics Printer), and the IBM Proprinter dot matrix printers. ITT Qume also offers modules that emulate the Hewlett-Packard LaserJet Plus and the Qume Sprint daisy wheel printers.

Everything is not as rosy as the color scheme would have it seem. The overall performance of the Three-In-One emulation module was disappointing. When we originally tested Version 1.1 of this module, the printer managed 4.9 pages per minute. When we tested the updated module (Version 1.2) that ITT Qume sent us, the speed dropped to 3.8 ppm. When we tested the HP LaserJet Plus emulation module, we obtained a more reasonable 8.8 ppm from this 10 ppm-rated printer.

Installing the LaserTENPlus entails inserting the drum assembly as well as the toner hopper/developer unit. Although the process is more complicated than that required for Canon-engine printers, it is not

very difficult. Inserting the loose toner presents fewer problems than does the similar process for Ricoh engines, primarily because the LaserTENPlus's toner hopper is at the top of the printer and does not rest on the paper tray.

Like a few other laser printers, the LaserTENPlus comes with an interface module connected in the rear of the printer. The interface module resembles a video game control panel. Close to 1 foot long and 5 inches wide, it includes a parallel cable on the left side and a bank of DIP switches in the center. The easily reached DIP switches let you set the emulation, zero style (slashed or unslashed), emphasized type, and condensed print.

Two more banks of DIP switches below the interface module, on the printer itself, enable you to set the form length and line-feed with a carriage return; in Qume Sprint emulation only, you can use them to set the character pitch. You can also run a self-test and control the print density by using the two buttons located to the left of the interface module.

The LaserTENPlus top display panel includes three soft-colored buttons, which you use to execute a form-feed, set the manual feed option, and run a self-test. The self-test also prints a status sheet that displays the current version, the type of communications (parallel or serial) and any appropriate protocols, the form length and the character pitch, and a printout of the current font's characters. A number of lights on the panel signal paper jam, low toner, ready status, and so forth.

The paper path on the LaserTENPlus is S-shaped. The paper enters from the tray on the front of the printer and emerges from its top facedown and collated. Since the sheets simply sit on the top and do not fall into a tray, however, they eventually begin to push one another off toward the front of the printer. As a result, you cannot print more than ten pages during a run without baby-sitting the collation process.

The LaserTENPlus comes with two fonts built in: a 10-point Courier that can be oriented either as portrait or landscape and a 7-point Courier that can be used only in landscape mode. The quality of the highly legible fonts is good. Other fonts are available from optional font cartridges that fit into the three font cartridge slots.

The printer produces most of the enhancements and features of the Epson FX-80, IBM Proprinter, and IBM 5152 Graphics printers it emulates. The exceptions are mainly limited to features specific only to dot matrix printers. In addition to supporting the escape code sequences for double-wide, emphasized, double-strike, condensed, and elite-style print, the LaserTENPlus also supports Epson's Select New Print Mode code.

The Epson graphics emulation wasn't up to par. The printer failed to print the first letter of the text it was sent and insisted on overprinting a few additional characters further in on the line. While this glitch appeared only on the first page of the graphics test, it occurred consistently.

A number of other laser printers on the market make the LaserTENPlus pale by comparison—even if they are drab gray and do not come standard with interface cables and collated output.

—Vincent Puglia

PC MAGAZINE FACT FILE



Qume LaserTENPlus
Qume Corp.
2350 Qume Dr.
San Jose, CA 95131
(408) 432-4000
List Price: $3,395
Dimensions (HWD): 15 × 17.25 × 20 in.
Weight: 90 lbs.
In Short: Distinguished by pastel-colored controls and based on the Hitachi engine, this 10 ppm-rated laser printer tested at 8.8 ppm in HP emulation mode but managed a sluggish 3.8 ppm when using the Three-In-One (Epson FX-80, IBM Proprinter, and IBM 5152 Graphics printer) emulation module.

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Ricoh PC Laser 6000

If small is beautiful, the $2,395 Ricoh PC Laser 6000 is a masterpiece. Based on the new Ricoh 1060 laser print engine, which is about two-thirds the size and about half the weight of competing engines, this compact printer set a new standard for size and weight when it was introduced. Since its release, other small laser printers have appeared, but the Ricoh PC Laser 6000 still has some features that set it apart from the competition.

The new 1060 engine (which is also used by the Okidata Laserline 6 and the Epson GQ-3500) is rated at 6 pages per minute which is 2 ppm less than the Canon-engine printers. Unlike almost every other laser we tested, the Ricoh PC Laser 6000 lived up to its rating. Most of the other printers fell short of their rated

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Ricoh PC Laser 6000
Ricoh Corp.
155 Passaic Ave.
Fairfield, NJ 07006
(201) 882-2000
List Price: $2,395; $199 for HP LaserJet emulation card
Dimensions (HWD): 16.5 × 16.1 × 8.1 in.
Weight: 37.5 lbs.
In Short: Priced competitively and offering excellent print quality, the 6-ppm Ricoh PC Laser 6000 has a good mix of features and forgivable faults; most users will want to purchase the optional HP LaserJet Emulation module from the start.

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speeds by 10 percent to 35 percent. In actual production settings, the lower rating of the Ricoh PC Laser 6000 may not be that significant.

The printer comes with four resident fonts. The Courier is a standard 10-pitch monospace font, as is the 12-pitch Prestige. Letter Gothic is a 15-pitch monospace suitable for compressed type, which I found more attractive and easier to read than the Line Printer type style used by many other laser printers. The Ricoh PC Laser 6000 also includes a proportional type style, Century, which comes in a 12-point font.

The Ricoh PC Laser 6000 answers to its own proprietary command set, which has not seen widespread acceptance so far from software developers. It also comes with Diablo 630 emulation, but since this provides only limited access to laser print features (such as graphics), you will probably do best to consider purchasing one of the emulation options. The HP LaserJet Plus emulation ($199) is perhaps the most useful choice, as it provides the broadest support for laser print features like proportional fonts. For this reason we tested the 6000 with the HP LaserJet Plus option installed.

PRINT QUALITY Running in HP LaserJet Plus mode, the Ricoh PC Laser 6000 performed flawlessly. It was able to execute correctly all the HP commands in the test sequences, and the print quality was outstanding. Ricoh has rapidly built a reputation in the desktop laser market for being able to print solids, even blacks, and this new little engine is no exception. Beyond that, the PC Laser 6000 was able to produce one of the best HP LaserJet emulation graphics samples I have seen. The gray shades were distinct, with only the slightest toner washout around the edges. The pinstripes in the circle called for by our graphics test were exceptionally crisp and well defined.

The 1060 print engine offers both manual and cassette paper feed, and both facedown and straight-through faceup paper output. These choices offer maximum flexibility in paper-handling—short of a second paper tray. One nice touch is that the input cassette can be reloaded without having to remove it from the printer. The input tray holds up to 150 sheets of paper—less than some competing machines, but adequate for most applications.

As in earlier Ricoh designs, the 1060 print engine relies on separate consumable components, such as toner, drum, and developer units. These make installation and setup a bit more difficult, and the optical drum is dangerously exposed to damage when you go to insert it. The engine also requires that you press a small metal tab that sticks down from the top of its insides whenever you replace the drum. The tab resets the copy counter that tracks how long the drum has been in use and halts the machine when it is time for a replacement. This step is clearly diagrammed and explained in the manuals, but I missed it and wasted time trying to determine why I was getting a message to replace the drum when I had just installed a new one.

The printer sports a control panel that looks out of date compared to newer designs. There are two separate single-character indicators, unlike the more conversational displays on other printers that offer a line or two of prompts in English instead of digits. Eight buttons provide access to the programmable parameters and a small dial permits you to select different paper sizes. In addition, there are 11 different icon lights that indicate different ready or error conditions.

PROGRAMMING STEPS The programming steps required to set the PC Laser 6000's parameters are not any more difficult than for other printers, but the cryptic prompts offer more of a challenge than information about where you are in a given sequence. Once you have set the values to the desired settings, you can print out a status page that lists the current parameter values, which is a valuable aid.

As one of its standard features, the PC Laser 6000 comes with 1 megabyte of RAM, which is handy for printing large blocks of graphics or for using downloaded fonts. The printer also comes with both parallel and serial ports. Setting it up is relatively easy, and the port selection can be made through the front panel.

The manual that comes with the printer and the supplement that comes with the emulation card are clear and well illustrated. The supplement to the HP emulation card is thorough and is one of the few manuals I've seen that does an adequate job of explaining the complexities of the HP LaserJet command set. The manual even explains how to code fonts for downloading and how to create macros, including several short BASIC programs that illustrate the use of these features.

Without the HP emulation, the PC Laser 6000 is not a particularly attractive value. At $2,395, including the emulation, however, it is competitively priced with other machines of similar capabilities. It's a little slower and cannot use ROM font cartridges in HP emulation mode, but it comes with a megabyte of memory and has a resident proportional font. Overall, this combination is of comparable value to that of other top products in the price range, and the Ricoh PC Laser 6000 is worth consideration.—**Alfred Poor**

Texas Instruments OmniLaser 2108

What do you want in a laser printer? Good print quality? PostScript compatibility for desktop publishing? HP LaserJet emulation to support complex text and graphics? Standard dot matrix and daisy wheel command sets to work with just about every software package on the market? And how about plotter emulation? To get all those options, you could buy two or three of the other laser printers reviewed here. Or, for about the same price as a printer that only offers PostScript, you could have it all in a single machine—the $5,995 Texas Instruments OmniLaser 2108.

This 77-pound powerhouse from Texas Instruments is a wonderfully odd mix of the old and the new. It is based on an older print engine, the Ricoh 4081, which is well known both for its ability to produce sharp and solid blacks and for its limited paper-handling features. On the other hand, its electronics are thoroughly modern and its flexibility is tough for the competition to match.

The OmniLaser 2108 sports a 250-sheet paper tray and offers the additional convenience of facedown, collated printouts. These perks are very handy to have, but you may miss the manual-feed and straight-through, faceup paper path op-

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tions offered by many of the other popular print engines.

The large Ricoh engine also has an interesting design for loading consumable components. You gain access to these essential items by pulling open a drawer on the front of the printer; but there is neither a catch that holds it in place nor a restraint to keep you from pulling the drawer all the way out of the printer.

The toner comes in a small, box-like cartridge that is emptied into a bin mounted on the inside of the drawer. (In the original designs, there was a hatch that sat on top of the cartridge, but on the OmniLasers, the cartridge case serves as its own cover.) The problem comes when you pull the drawer open without sufficient caution, and the drawer tumbles to the floor cascading toner all down your front as it goes. And as with many other engines that use separate components, the drum is exposed to possible damage when it is being inserted.

PC MAGAZINE FACT FILE



Texas Instruments OmniLaser 2108
Texas Instruments
P.O. Box 809063
Dallas, TX 75380-9063
(800) 527-3500
List Price: $5,995
Dimensions (HWD): 21.5 × 23.5 × 15.5 in.
Weight: 77 lbs.
In Short: Numerous connections and powerful emulation options overcome the limitations of out-dated paper handling and the nuisance of handling the toner and drum of this competitively priced, 7.4-ppm PostScript printer.

CIRCLE 643 ON READER SERVICE CARD

NEW CONTROL PANEL The first printers based on the Ricoh 4080 and 4081 engines could also be identified by their Spartan control panels. This is one feature that Texas Instruments has changed considerably. Instead of the cryptic LED codes, indicator lights, and a button, the OmniLaser 2108 comes with a full-featured control panel. To start with, a 16-character LCD window lets your printer converse with you in English. Standard messages include "Printing," "Processing," and "Idle." Error messages are equally clear. The OmniLaser 2108's front panel also offers a full complement of ten buttons. These are clearly labeled and can be used to program most of the different printer features such as emulation mode, default font, and interface configuration.

The interface presents another example of the OmniLaser 2108's flexibility. It offers the typical Centronics parallel and 25-pin serial connectors, and you can configure the printer to use one or the other (with an incredible 16 different serial baud rates available). A 9-pin connector can be used instead of the other two, and it can be configured as either an RS-422 serial interface or an AppleTalk connection. This combination of options should mean that this printer can talk to almost any Personal Computer around. The printer also comes with diagrams showing the pinouts for cables used to hook up a variety of popular computers, including the PC 25-pin and AT 9-pin serial connectors.

The cables are described in an appendix of the Technical Reference Manual, which covers both the 2108 and its larger sibling, the 2115 (also reviewed in this isssue). Well illustrated and thorough, this manual includes tables of commands recognized by the different command sets. There is a short discussion of the HP LaserJet Plus font attribute hierarchy, as well as detailed descriptions of how to use the printer's downloadable font and macro capabilities. There is also detailed information on the PostScript and HPGL plotter command sets.

The printer also comes with a separate operator's manual, which describes how to set up the printer and perform maintenance procedures, such as changing the consumable items. Liberal use of illustrations makes these tasks as easy as they can be. This manual also includes a section on troubleshooting problems and the possible causes and solutions of poor print quality. Overall, the OmniLaser 2108 gets good marks on its documentation.

GOOD PERFORMANCE The true measure of a printer, however, is its performance. The OmniLaser 2108 produced excellent results. Rated at 8 pages per minute, the OmniLaser 2108 was fastest in the PostScript emulation at 7.4 ppm. Under the PostScript tests, it printed excellent graphics images, with the clarity and even dense blacks for which the Ricoh-based printers are known. It did an excellent job of producing fonts in its resident Helvetica, Times Roman, and Courier type styles.

The surprises came when I ran the PC Lab tests on the OmniLaser 2108 under its HP LaserJet Plus emulation. It failed to handle the graphics images as precisely as it did under PostScript. On the other hand, it was able to produce fonts on the fly, generating them from the type style outlines that are part of the PostScript controller. And because the OmniLaser 2108 comes with 2 megabytes of memory as a standard feature, it should have plenty of memory for graphics and fonts.

The OmniLaser 2108 is hampered by its limited paper handling, but its range of interfaces and multiple emulations gives it exceptional power and flexibility. If your printer requirements include PostScript support, this is one printer to take seriously.—**Alfred Poor**

Texas Instruments OmniLaser 2115

Why would you spend nearly $8,000 for a laser printer when you can buy four dot matrix printers at list price and still spend less? For this much money, a printer had better be good.

The $7,995 Texas Instruments OmniLaser 2115 is good. It's a PostScript printer that comes with outlines for three typeface styles and 3 megabytes of RAM, and builds from there.

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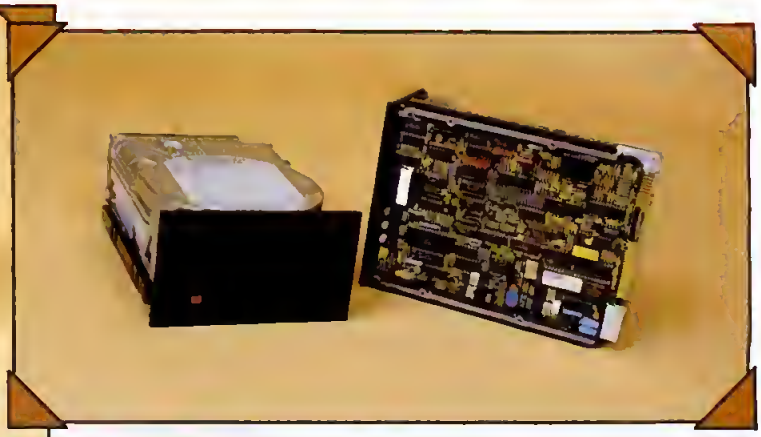
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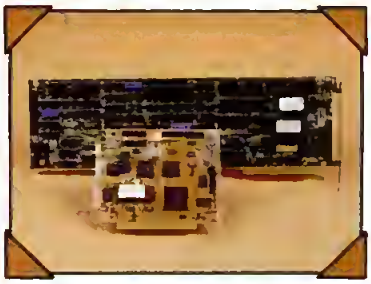
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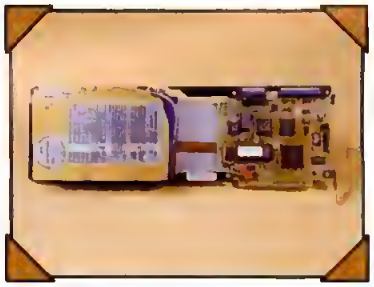


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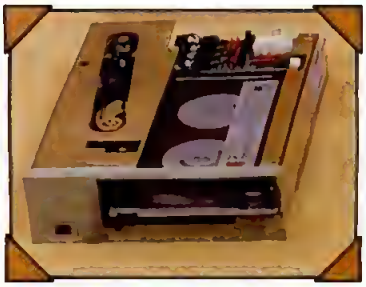
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the added capacity of two 250-sheet-input paper trays. However, the printer has neither manual feed nor a straight-through paper path as options, so paper handling is not as flexible as that of some competing designs. The Ricoh engine also uses separate consumable components that are installed in a removable drawer: this is not the most convenient design around, and installing the exposed drum can be a little tricky.

The engine is rated at 15 pages per minute for letter-sized pages (only 7.5 for legal size), but speed does not appear to be the OmniLaser 2115's strongest feature. The best performance I could coax from it with the PC Labs speed test was 9.5 ppm under the HP LaserJet Plus emulation. But the OmniLaser 2115 can stand on its own, despite this performance, because of its other features.

The electronics inside the printer give the machine its flexibility and power. As a PostScript printer, the OmniLaser 2115 generates fonts from its built-in typeface definitions and can get the most out of the latest desktop publishing programs. And because it can emulate the HP LaserJet Plus, its ability to support a wider variety of programs is extended. One surprising benefit of these paired emulations is that the HP LaserJet mode can call on the PostScript controller to generate requested fonts if they are not available as cartridge or downloadable fonts. Since the printer comes with outlines for Times Roman, Helvetica, and Courier, the font needs of most users are covered.

The OmniLaser 2115 does not stop here, however. To fully cover the installed base of software, three more emulations are included. The TI 855 mode has two versions: one resembles a Qume Sprint 11 Plus daisy wheel and the other uses a command set similar to an Epson MX-80. In case that is not enough, Texas Instruments threw in the kitchen sink in the form of a Diablo 630 emulation (another daisy wheel) and an HP 7475a emulation, which is a plotter that uses the HPGL command set. You will have to search your software library carefully to find a package that won't work with at least one of these modes.

These emulations are accessible through the well-designed front-panel controls of the OmniLaser 2115. Unlike most other laser printers built on the large Ricoh engines, the OmniLaser 2115 offers more than just a pair of LED characters and a button. There is a 16-character LCD window that presents prompts in English, as well as an 11-button keypad. The buttons control such standard functions as on-line/off-line and page eject, and allow easy access to such programmable features as emulation mode and interface configuration.

The printer goes beyond the standard limits of interface options. The OmniLaser 2115 offers the typical choice of parallel or 25-pin serial connections. The serial interface can be easily configured to run at any one of 16 different bps rates, including four speeds faster than the typical 19,200-bps limit. The OmniLaser 2115 also supports speeds up to 57,600 bps. In addition, it carries a 9-pin connector that can be appropriately configured either as an RS-422 serial interface or as an Appletalk connection.

Installation, configuration, and operation are made as easy as they can be with the aid of two well-designed manuals. The illustrated operator's manual covers setup and installation of the various components. It also lists the error messages and offers suggestions on how to diagnose common printing problems. The technical reference manual covers both the OmniLaser 2115 and its smaller sibling, the OmniLaser 2108 (also reviewed in this issue). This manual does a good job of listing the commands recognized in the different emulation modes. It explains the HP LaserJet Plus font attribute command hierarchy and contains detailed information on downloaded fonts and macros.

The quality of the OmniLaser 2115 output is excellent, although the graphics images produced under the HP LaserJet Plus emulation were fuzzier and more uneven than the ones produced in PostScript mode. The letters are well defined and attractive, and the machine's ability to create fonts on the fly in the HP LaserJet mode is a definite plus.

The OmniLaser 2115 offers emulation power, a big memory, flexible and speedy interface options, and a large paper capacity. These strengths are offset by mediocre output performance (when compared with its rated speed) and limited paper-handling options. The result is a printer that offers a fair return for the money. If you need a PostScript machine with extra memory and dual input trays, this is one of the few machines at any price that can fill the bill.—**Alfred Poor**

PC MAGAZINE FACT FILE



Texas Instruments OmniLaser 2115
Texas Instruments Inc.
P.O. Box 809063
Dallas, TX 75380-9063
(800) 527-3500
List Price: $7,995
Dimensions (HWD): 17 × 21.5 × 28 in.
Weight: 88 lbs.
In Short: Armed with two 250-sheet paper trays, PostScript support as well as four other emulations, and 3 Mbytes of memory, this is an expensive but powerful 9.5-ppm printer. Its limitations are that it has few paper-handling features and that changing consumables is not as easy as it is on other designs.
CIRCLE 620 ON READER SERVICE CARD

Varityper VT-600

Are PC users ready for a 600-dot-per-inch PostScript laser printer? Without a doubt. It's not uncommon for people to remark that output from a conventional 300-dpi laser abounds with jaggedness. The Varityper VT-600 will shut them up for good.

Rather than calling the 5.6-page-per-minute VT-600 a printer, Varityper refers to this $18,750 laser as a "plain paper typesetter." It's an awesome machine containing a huge print engine, a 68020 microprocessor, 6 megabytes of memory,

and—a first for printers reviewed in *PC Magazine*—a 20-megabyte hard disk. The hard disk is used for virtual memory and for storage of downloadable fonts.

The 160-pound Varityper VT-600 requires installation by a service engineer. You'll need a strong table ready and a dedicated outlet that can handle 1,000 watts. Varityper recommends that you take out a service contract, which includes monthly maintenance, yearly drum replacement, and all parts and labor. The annual charge ranges from $2,950 to $4,662, depending on your distance from a Varityper service center.

A controller unit, which contains the electronics, sits on top of the printer itself.

The best feature of the Varityper VT-600 is its resolution. At 600 dpi, it gives you four times as many dots as does a 300-dpi laser printer.

Two on/off switches must be turned on in sequence—printer first, wait 15 seconds, then controller. Except for a dial on the back of the unit that sets the interface to parallel, serial, interactive serial, or AppleTalk, and a density adjustment on the inside, there are no other user controls. A series of status lights on the controller and printer units tells you what's going on.

The Operator Guide for the VT-600 is a skimpy 28-page manual that goes over the basics of interpreting the status lights, adding toner, dealing with paper jams, and when to call for service. There is also a 54-page PostScript Supplement manual that is available mostly for people who intend to write their own PostScript routines for the printer.

Obviously the best feature of the Varityper VT-600 is its resolution. At 600 dpi, it gives you four times as many dots as does a 300-dpi laser printer (600 by 600 versus 300 by 300). That's a significant and important increase. Although real typeset quality is generally considered to be 1,200 dpi or better, only marginal improvements in quality in text and graphics are apparent above 600 dpi.

But are 600-dpi laser printers ready for PC users? Judging from this one, not quite yet, I'm afraid. The problem is that high resolution is the only good feature of the Varityper VT-600.

There's nothing wrong with the VT-600 that Varityper, a manufacturer of high-quality printing equipment, can't fix. Doing so would require Varityper to gain a better understanding of the minimum standards that PC users expect in hardware peripherals. We really don't demand that much—only things like compatibility with existing hardware and software, receiving a machine equipped with the most recent ROM chips, and getting disks that can be used on a PC rather than an Apple Macintosh. Is that asking too much?

WORK TO BE DONE A discussion of some of the problems we encountered while testing the VT-600 will shed some light on the kind of work Varityper must do if it is to have a competitive product.

Some explanation is needed first. PostScript requires that fonts be selected through commands that explicitly name the typeface. Although the Apple Macintosh can interrogate a PostScript printer to determine the fonts stored in the printer, a PC applications program usually cannot. This is because the printer might be connected to the PC through the parallel port, which is only unidirectional. The applications program must therefore make assumptions about the fonts that the printer supports. Virtually all PostScript printers include at least the standard Courier, Helvetica, Times Roman, and Symbol fonts.

The Varityper VT-600 as originally installed for us did not include the Helvetica or Times Roman fonts. It had Courier, Symbol, and an imitation Times Roman called "Varitimes." If a PC applications program tries to print in Times Roman and the PostScript printer does not have that font, the VT-600 printer will default to Courier. But the Courier font will be printed as if it had the same character widths as Times Roman.

The solution to this problem is to download some additional fonts to the VT-600, including the real Times Roman font. These fonts can be stored on the printer's hard disk, so the job need only be done once. Varityper was able to supply us with disks containing additional fonts and a program to download them into the printer. Unfortunately, these were Macintosh disks and Macintosh programs, which obviously were of little use to us.

This is not entirely Varityper's fault. The disks are supplied to Varityper by Adobe Corp.—the creators and licensers of PostScript—and they are not yet available from Adobe in PC format. But we all know that many hardware manufacturers of PC peripherals write their own support software (or contract out the job) and include it as part of the package. Why can't Varityper do the same?

Fortunately, *PC Magazine* is not entirely a Mac-less office, so we were able to download several fonts onto the VT-600's hard disk. But we never did get the real Times Roman font; instead, we had to customize the PC Labs benchmark programs to use Varitimes.

PC MAGAZINE FACT FILE



Varityper VT-600
Varityper
11 Mount Pleasant Ave.
East Hanover, NJ 07936
(800) 631-8134
(201) 887-8000 ext. 999 (in N.J.)
List Price: $18,750
Dimensions (HWD): 18.7 × 43 × 21.5 in
Weight: 160 lbs.
In Short: A 600-dpi PostScript laser printer that produces beautiful output at 5.6 ppm but is not quite ready for the PC community.

CIRCLE 655 ON READER SERVICE CARD



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CIRCLE 202 ON READER SERVICE CARD

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APRIL 28, 1987

PC HANDS ON

BY JONATHAN MATZKIN

Has the fun gone out of the romance with your printer? Well, perhaps what you need is a little *Pizazz* to make things exciting again. Technically, *Pizazz* is a memory-resident print utility, but it is really more like a turbo-charger for your PrtSc key.

JULY, 1987

PC WORLD

SOFTWARE HITS OF 1987
By Ross Smith

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CIRCLE 115 ON READER SERVICE CARD

■ LASER PRINTERS

PC MAGAZINE EDITOR'S CHOICE

- **Hewlett-Packard LaserJet Series II**
- **NEC Silentwriter LC-890**
- **Okidata Laserline 6**

Of the three laser printers under $2,000 that we evaluated, one stands out. The $1,995 Okidata Laserline 6 (including the single-user personality module) has more built-in fonts than the HP LaserJet that it emulates. Beyond that, a diskette of LaserControl *software provides Diablo 630, NEC 3550, Qume Sprint 5, Epson MX-80, and IBM Graphics Printer emulations; hence the printer can use a wellspring of popular software packages. Making the package even more attractive is a $400 multiuser personality module, which allows three personal computers to be hooked up to one Laserline 6, bringing the cost of the printer down to less than $800 per user. Although the Laserline 6's 150-sheet paper tray is a bit on the skimpy side, what you'll see on those 150 sheets is print quality that's solid and black. Considering that you can buy the Laserline 6 on the street for about $1,400, it's a hard deal to pass up.*

The easiest call we had to make was choosing the $2,595 Hewlett-Packard LaserJet Series II. Forty percent cheaper than the HP LaserJet Plus that it replaced, the Series II maintains its standing as the laser printer by which all others are measured. Building on the features that made the earlier LaserJets a success but without sacrificing compatibility, the Series II accepts HP downloadable fonts and supports the whole HP command set. Its smaller size, reduced weight, and ability to go the extra distance when printing large areas of black are dividends of the new 8-ppm-rated Canon SX print engine. With more fonts (Courier, Courier Bold, and Line Printer, all in portrait and landscape) than its predecessors, a 200-sheet paper tray, an improved 16-character front panel, facedown paper stacking, two font cartridge slots, and an I/O expansion slot, the HP Series II is destined to be a point of reference for some time to come.

Although the Apple LaserWriter Plus (reviewed last year) is still the PostScript printer to beat, the $4,795 NEC Silentwriter LC-890 has a lot to offer for the money. Besides being PostScript compatible, the 6-ppm LC-890 offers HP LaserJet Plus and Diablo 630 emulations, which allow it to work with software packages from the most intelligent to the most primitive. Other similarly priced printers, such as the $4,995 Laser Connection PS Jet and the $5,495 QMS PS-800 Plus, also offer these options, but the NEC LC-890 produced the clearest, darkest output of this group. Equipped with parallel, serial, and AppleTalk ports, 3 megabytes of memory, two 250-sheet paper trays, and all the fonts found in the Apple LaserWriter, this large machine should stand up under heavy use.

An honorable mention goes to the $3,495 Dataproducts LZR 1230 for its 10.9-ppm measured speed, three I/O ports, and rugged construction. As many as three personal computers running software configured for different emulations can be linked to the LZR 1230 at the same time. Also worth considering for multiuser environments are the $3,495 Genicom 5010, which has a rated duty cycle of 15,000 pages per month, and the $3,795 Quadlaser I, which has a rated duty cycle of 10,000 pages per month.

Oh, The Logic Of It All!

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All PostScript printers that I've seen have a Diablo 630 emulation mode so the printer can be used to print straight ASCII text. The Varityper VT-600, however, has no emulation mode. Although Varityper believes that Diablo 630 emulation is not necessary on typesetting equipment, I think that any printer that can be connected to a PC should have a means to print ASCII text. If nothing else, this would be useful for determining if the interface between the printer and the PC is working correctly. You put the printer in Diablo 630 emulation mode, hit the PrSc key a few times, and wait to see if anything comes out. If so, then you copy a big ASCII file to the printer and wait to see what happens.

I sorely missed this facility. The VT-600 as originally installed absolutely refused to complete the PC Labs benchmark speed test. I didn't know at first if it was an interface problem or a problem with the printer's PostScript interpreter. It turned out that the printer had an old version of PostScript that didn't work correctly with the parallel port. We needed new ROM chips. After the service engineer installed new ROM chips, the printer didn't work at all. Back to Varityper with the printer system board

The Varityper VT-600, however, has no emulation mode. Although Varityper believes that Diablo 630 emulation is not necessary on typesetting equipment, any printer that can be connected to a PC should have a means to print ASCII text.

We saw a lot of the Varityper service engineer during this time. We had real doubts about his familiarity with the machine. The constantly blinking toner status light didn't seem to bother him, for example. He shrugged it off. We begged for more toner. A second bottle of toner made the light stop blinking and improved the quality of the printed pages considerably. Imagine that!

As I said earlier, there's nothing wrong here that can't be fixed. I hope Varityper can do it. I hope the VT-600 is reviewed again in next year's printer project. I hope that next year the reviewer can concentrate on the features of the VT-600 rather than on the hassles.—**Charles Petzold**

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PC Magazine
March 31, 1987



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CIRCLE 531 ON READER SERVICE CARD

DOT MATRIX:

Known for their durability and dependability, 9- and 24-pin dot matrix printers do more, cost less, and are faster than ever.

Women's magazines run on endlessly about the search for Mr. Right. Perhaps their readers should face reality and instead search for Mr. Bell Curve—the guy who falls within one or two standard deviations of perfection. A dot matrix printer represents the same kind of trade-off: it may not be exactly what you want, but more than likely, it will be what you need—or get.

In a world filled with compromises and budget committees, a dot matrix printer is what, statistically, you're most likely to wind up with. Two out of every three printers sold today are dot matrix, and that proportion will probably hold over the next few years. The rest of the market is split between lasers (about a tenth of the market and climbing fast) and daisy wheels (also moving fast, in the opposite direction).

An impact dot matrix printer is the jack-of-all-trades, the only printer that can produce graphs and DNLQ (darn near . . .) text, handle 11- by 14⅞-inch printouts, multipart forms, and color—all without taking up much space on the desk. If there's nothing a dot matrix printer is a master of, there's nothing it really can't do, or at least take a stab at.

Dot matrix printers also represent excellent value. Look at the bang-for-the-buck chart comparing the top sellers and *PC Magazine* Editor's Choices of the past 3 years against this year's top printers, and you'll see the kind of progress being made by the printer industry. Besides more speed for fewer dollars, today's dot matrix printers have

- Smaller footprints.
- More fonts and type widths, beyond the usual draft/NLQ/compressed options. Many have proportional fonts built in, and many of the 24-pin printers take additional font cartridges, cards, or chips. These are usually inexpensive, especially when compared with laser-printer rates ($200) for extra fonts.
- Better paper handling, including semi-automatic paper loading and the ability to print an envelope or a single sheet without removing the tractor-feed paper.
- Sheet feeders. Three years back, this would have been a joke, since cut sheets often imply company letterhead stationery that calls for best-foot-forward print quality. Now, with the quality up and the world more accepting of DNLQ printing, cut sheets make lots of sense. Even if you just print on nondescript paper swiped from the photocopier (c'mon, admit it—everyone does), it's such a delight to be freed from ripping apart all those perforations.
- More ribbon choices. Look for more manufacturers to offer film ribbons (the Mylar multistrike ribbons, often called carbon ribbons) that do wonders for 24-pin printers.
- Color. It used to be a separate model or an expensive option. Now, with many printers, you just slap on a red-blue-yellow-black ribbon and you're in business.

HOW MANY PINS? The majority of dot matrix printers are the 9-pin units that have about 85 percent of the market, with the rest being 24- and 18-pin designs. Expect to see the market share of 24- and 18-pin printers double or triple in the next 4 or 5

THE JACK-OF-ALL-PRINTERS



Illustration: Javier Romero

years. Dot matrix technology also includes non-impact ink jet printers and thermal transfer printers that hold small market niches, but important ones nonetheless.

Twenty-four-pin printers, with two columns of 12 pins, aren't automatically superior to 9-pin printers for all tasks. Just most of them. The matrix, or box, that makes up each character can be ten times as detailed in 24-pin, proportional-spaced NLQ mode as that of a 9-pin printer in everyday draft mode. Because of their staggered-pin offset, 24-pin printers can run faster in draft mode and need only a single pass to do near-letter-quality.

Even with the best 24-pin printers, there remains some discernible difference between true Selectric/daisy wheel/laser printer letter quality and dot matrix printer near-letter-quality. It's not that bad if you don't look closely, and most people *aren't* looking closely in the "does-she-or-doesn't-she—only-her-hairdresser-knows-for-sure" sense. The business world is growing accustomed to seeing correspondence on dot matrix printers; as long as the print quality doesn't pain the eyes, the message really does count more than the medium for most but not all crucial documents.

Besides 9- and 24-pin printers, Okidata and Alps, among others, offer 18-pin printers arranged in two columns of 9. Eighteen-pin printers typically emulate 9-pin Epson printers, which was an advantage a year or two ago when there weren't many 24-pin printers except those by Toshiba. Okidata says the dual-9 arrangement makes for faster text and graphics. Oki's 18-pin Microline ad campaign claims output is 2 to 6 times faster than that of comparable 9-pin printers; PC Labs didn't find that to be the case with text, at least.

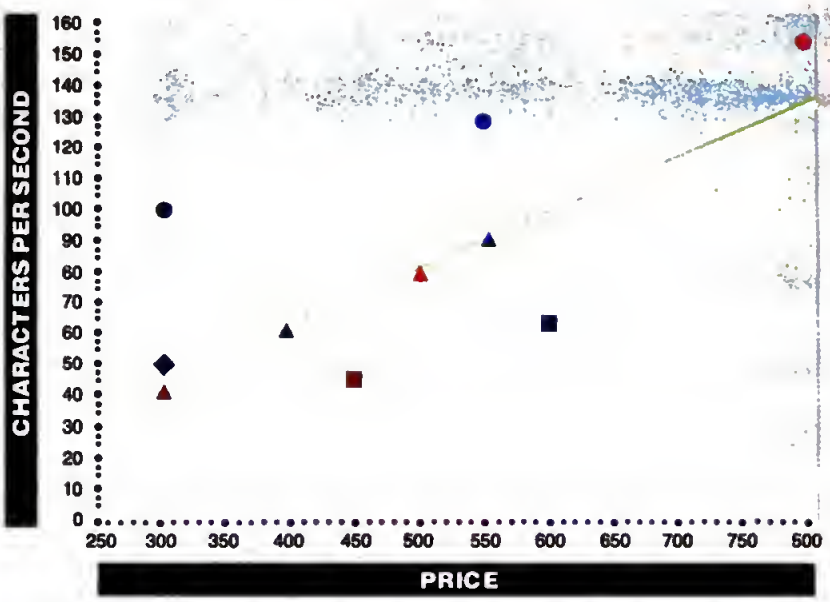
Japan Inc. (that's where almost every printer comes from these days) has a bunch of 32- and 36-pin designs ready or on the back burner, but it's unclear how much the quality improves beyond 24 pins. It's equally uncertain how soon—if ever—these designs will come to market.

WHY NINE? If 24-pin printers are so hot, why don't they have 100 percent of the dot matrix printer market?

Those ubiquitous 9-pin printers from

Low-End Dot Matrix Printers: Bang for the Buck

Today's dot matrix printers do more and run faster than their predecessors. This bang-for-the buck chart compares cost against speed for *PC Magazine*'s Editor's Choices of the past 4 years and several other popular printers. All are affordable 9-pin (except one), narrow-carriage dot matrix printers. Printers above the line represent a better price/performance ratio; below the line, poorer. Note the Epson LQ-850's superior price/performance ratio, even with the added cost of the 24-pin head. The same holds true for wider-carriage printers and laser printers.



Model	Year	Characters per second	Price
Epson LQ-850	87	153	$799
IBM Proprinter II	87	129	$549
Panasonic KX-P1091I	87	99	$289
RCA VP2100	86	51	$299
C. Itoh ProWriter Jr.	85	43	$299
Epson FX-85	85	80	$499
IBM Proprinter	85	91	$549
Panasonic KX-P1091	85	59	$399
Epson FX-80	84	63	$599
IBM PC Graphics Printer	84	45	$449

Epson, IBM, Okidata, and Panasonic retain three advantages: price, print density, and apparent durability. Based on PC Labs' tests over the past 4 years and on everyday experience, we've found that 9-pin printers produce somewhat darker characters over the lives of their ribbons than do 24-pin printers. Ribbons typically produce crisp, dark print for just a few pages (about 50 to 100), then several thousand somewhat fainter pages. (Daisy wheel printers using nylon fabric ribbons perform the same way.) Each wire, or pin, on a 9-pin or an 18-pin printer has about twice as much surface area as a pin on a 24-pin printer, about .3 millimeters across vs. .2 millimeters.

The daintier pin (.2 millimeters is about 1/128 inch) is also the reason why 24-pin printers shouldn't hold up as well, at least in theory. In practice, all dot matrix printers are rugged; if 9-pin printers seem to last forever and 24-pin printers last 90 percent as long—well, that's more than adequate, isn't it?

Bear that in mind as you read the 57 dot matrix printer reviews that follow. Also, where PC Labs found some printer housings to be of comparatively thin plastic, or where the machines seemed less solidly heavy than in years past, don't assume that the printers are inferior. Instead, the engineers and designers may have found ways to make less do more and shave a few pennies off manufacturing costs. When the yen is climbing, you don't get falling printer prices without some compromises.

COLOR RIBBONS Many higher-end dot matrix printers now accept four-color red-blue-yellow-black ribbons to produce color images and graphs. The best color images can be quite good.

If it's color you want, you should consider the thermal transfer color printers and color ink-jet printers also reviewed here. Until the dominant corporate printing presses—photocopiers—all work in color, the use of color output remains limited to passing around a handful of originals or to displays on overhead projectors. That could change with color laser printers.

Two special-purpose machines reviewed in the dot matrix category are Brother's Twinriter 6, which has both daisy wheel and dot matrix printheads in the same machine, and IBM's Quietwriter III, which produces truly excellent output using thermal transfer technology. The latest version runs three times as fast for only $100 more—but when you're talking $1,699 for a quiet, letter-quality printer, you should be talking a 200- to 300-character-per-second laser printer.

As with the other categories, these printers are reviewed in alphabetical order by company name.—**Bill Howard**

Alps ALQ200 and ALQ300

Although the $595 narrow-carriage Alps ALQ200 and $895 wide-carriage ALQ300 are less-expensive versions of the $1,395 Alps P2400C printer, also reviewed in this issue, they do have most of the interesting and useful features of that higher-priced machine.

Like the Alps P2400C, the ALQ200 and ALQ300 are available in an 18-pin configuration, which emulates the Epson FX-185, and a 24-pin configuration, which emulates the Epson LQ-1500 and LQ-2500. The 24-pin unit costs $100 more than the 18-pin machine, but you don't have to sacrifice 24-pin printing if you purchase an 18-pin machine or vice versa. You can transform your 24-pin machine into an 18-pin machine by purchasing an 18-pin configuration kit. The $295 kit includes an 18-pin printhead and a system cartridge. If you have an 18-pin printer, you can buy a 24-pin configuration kit for $395.

To switch the two printheads, all you need to do is replace the printhead and the system cartridge, then move the line-feed pitch-control lever. You'll also need to be able to do 50 fingertip push-ups, because even though the task is simple, it requires some challenging finger maneuvers.

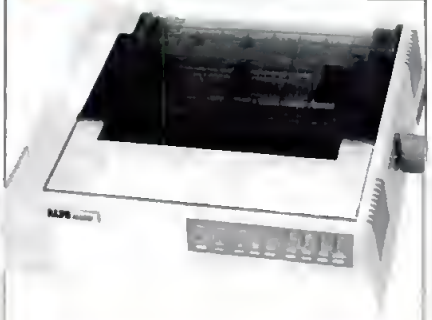
Other than this, setting up the printers is easy: for example, inserting the ribbon cartridge is literally a snap. But it would be a good idea to read the printer manual first, even for experienced printer users. When I first tried to use the ALQ200, it seemed as if the printer had failed its diagnostic self-test. After reading the setup instructions, I found that I should have checked to see if the line-feed pitch-control lever was set for the type of printhead that was currently installed.

The manual is well written and has clear and complete instructions for setting up the printer; it also includes descriptive chapters on printer commands and escape codes for both the Epson FX-185 and LQ-1500 emulations. If that's not good enough, you'll find the Alps technical support staff patient and helpful.

The front panel has an array of buttons and indicator lights that may look intimidating at first, but actually makes printing easier and lets the user feel in control. These buttons can be used to select letter quality, draft, or high-density print. You can also select line spacing of 6, 8, 3, or 4 lines per inch; character pitches of 10, 12, or 17; and proportional spacing.

You won't find yourself turning the printer off and on again to clear the buffer;

PC MAGAZINE FACT FILE



Alps ALQ200 and ALQ300
Alps America
3553 N. First St
San Jose, CA 95134
(800) 828-2577
(800) 257-7872 (in Calif.)
(800) 858-2577 (in Canada)
(408) 946-6000
List Price: ALQ200: 18-pin, $595; 24-pin, $695. ALQ300: 18-pin, $895; 24-pin, $995.
Dimensions (HWD): ALQ200: 5.6 × 18.5 × 18.5 in.; ALQ300: 5.6 × 24.1 × 15.8 in.
Weight: ALQ200, 30.9 lbs.; ALQ300, 37.5 lbs.
In Short: Narrow- and wide-carriage dot matrix printers that let you swap between 18- and 24-pin printheads, these impressive machines have a measured speed of 123 cps in draft mode.
CIRCLE 602 ON READER SERVICE CARD

the reset button takes care of that. You can even choose between the internal font, Alps Gothic, and an external font cartridge. Alps has three font cartridges for 18-pin machines and five font cartridges for 24-pin machines; each cartridge costs $55. You can change any selection within seconds.

The control panel offers you another option for making selections. By placing the printer in memory mode, you can easily make the selections mentioned earlier, as well as choose print color, international character sets, form length, command code set, and various communications settings. The options that you select while the printer is in memory mode are retained after you turn off the printer and become its new default.

Both the ALQ200 and ALQ300 have bidirectional, or push-pull, tractors. But there is an extra charge for this convenience: $65 for the ALQ200 and $85 for the ALQ300. You wouldn't want to be without this option, so you might as well add the appropriate cost to the price of the printer. There is also a handy do-it-yourself single-sheet feeder that you can construct by flipping one of the printer covers and fastening it in an upright position. Pressing the insert sheet button on the front panel brings the sheet to the top-of-form position. It is also possible to feed paper from the bottom: single- and dual-bin feeders are available separately at $195 and $125, respectively.

Other features include a .5-second diagnostic self-test that the printer performs each time it is turned on to check if all the internal mechanisms are functioning properly. Both the ALQ200 and ALQ300 have three easily removable plastic covers that do a good job of muffling the noise of the printhead.

Also impressive is the quality of the Alps machines' color printing. Using a multicolor (black, cyan, magenta, yellow) ribbon, the printers produce bright colors with a resolution of 120 dots per inch horizontally and 144 dpi vertically. The 18-pin letter quality print is good; the 24-pin letter quality, even better.

The characters are well connected and well formed, but they are not the best quality print for printers in this price range. The high-density mode is a nice-looking type that at 110 characters per second is really a slower draft print; it looks good enough for interoffice memos. The draft mode is good and runs at 123 cps for both the ALQ200 and ALQ300. The optional Courier font is more pleasing to the eye than the resident boxlike Gothic font but is not as dark. If you are not planning to use the ALQ200 or ALQ300 to write a letter for which appearance is everything, their hassle-free features can make either printer a pleasure to own.—**Erika Hortz**

Alps P2400C

A large and impressive dot matrix printer, the wide-carriage Alps P2400C sports features similar to those of its less expensive relatives, the $695 narrow-carriage ALQ200 and $995 wide-carriage ALQ300 (both reviewed in this issue). In fact, these printers are so much alike that all you really gain with the P2400C is an increase in speed of approximately 40 percent (or 47 cps) and a standard tractor-feed mechanism. All three machines are distinguished by their swappable 18-pin and 24-pin printheads, and all are satisfying to use.

Alps printers stand apart from other dot matrix printers in that their interchangeable printheads are what allow them to assume other identities. When configured as an 18-pin printer, the P2400C can emulate an 18-pin Epson FX-185 printer and can print the IBM high-order character set (with the exception of double borders). When set up as a 24-pin printer, the P2400C can emulate the Epson LQ-1500 and LQ-2500. Both configurations allow the printer to emulate the Epson JX-80 for graphics. When you purchase the printer, you specify whether you want 18-pin or 24-pin printheads and interfaces. The price for the P2400C with an 18-pin printhead is $1,295; a 24-pin configuration costs $1,395.

If you purchase a 24-pin P2400 and realize that you need an 18-pin printhead as well, don't worry. For an additional $295, you can turn your 24-pin machine into an 18-pin model by buying an 18-pin configuration kit, which consists of a printhead and system cartridge. Similarly, you can change your 18-pin P2400C into a 24-pin machine by purchasing a 24-pin configuration kit for $395. To change the P2400C's configurations, you simply swap printheads and replace an interface cartridge that is the size of a brick. Switching printheads did not present any problem, but my fingers got a workout when I removed the P2400C's interface cartridge.

Unlike the ALQ200 and ALQ300, the P2400C comes with a tractor-feed mechanism. It doubles as either a push or pull tractor, which allows you to work easily with multipart forms as well as with continuous-feed paper. The front panel is basically the same as that of the ALQ200 and ALQ300, allowing you to select such settings as print type and character pitch. In addition, the P2400C lets you bring paper to the top-of-form position without registering it in the printer's memory, which is an extremely useful feature.

Like the ALQ200 and ALQ300, the P2400C has a memory mode, during which you can select such options as characters per inch, lines per inch, print color,

FACT FILE



Alps P2400C
Alps America
3553 N. First St.
San Jose, CA 95134
(800) 828-2577
(800) 257-7872 (in Calif.)
(800) 858-2577 (in Canada)
(408) 946-6000
List Price: 18-pin, $1,295; 24-pin, $1,395.
Dimensions (HWD): 17.7 × 25.4 × 7.1 in.
Weight: 43.7 lbs.
In Short: A fine wide-carriage dot matrix printer that uses swappable 18-pin and 24-pin printheads, this machine differs from two of Alps's lower-end machines (ALQ200 and ALQ300) in that it offers a 40 percent faster draft mode (170 cps) and a standard tractor-feed mechanism.

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and international character sets from the printer's comprehensive menu. The P2400C's menu is almost identical to that provided with the ALQ200 and ALQ300, but it also lets you choose bold as a print variation and offers a top transmission rate of 19,200 bits per second.

If the color printing of the ALQ200 and ALQ300 was great, that of the P2400C was even more impressive. The colors are bright and crisp, and the letter quality color printing is superb. The black letter quality printing is not significantly better than that of the ALQ200 and ALQ300, and it runs at almost the same speed: 78 cps. The big difference is that the P2400C's draft print runs at 170 cps, while the ALQ200 and ALQ300 run at 123 cps. Depending on your needs, any of these printers can be a good buy.—**Erika Hortz**

AMT 250 Office Printer

You might want to scrape up $1,845 for the AMT 250 Office Printer, from Advanced Matrix Technology, if you can buy only one printer but want fast draft, state-of-the-art letter quality, terrific graphics in monochrome and in color, and a sturdy machine that can run for a long time. If you do buy the AMT 250, you'll be able to brag about its 18-pin dot-matrix print quality and its performance. In fact, it's one of the top all-purpose printers.

The AMT 250 isn't a speed freak, but at 160 characters per second in draft and 38 cps in its potent letter quality, it's not sluggish. The in-between, memo-quality print is a good compromise type that pumps out 85 cps.

Although the AMT 250's dotty-looking draft print is rough, its letter quality print is beautiful. And despite the fact that the AMT 250 uses only an 18-pin printhead (6 pins short of today's 24-pin standard for highest-quality dot-matrix printers), you have to see the tightness and the clarity of the characters to believe them.

The AMT 250 comes with plenty of features standard, but it also has a raft of options available to suit the printer to your needs. As delivered, the machine can print six-part forms up to 13.2 inches wide. Built-in fonts include Courier 10 pitch, Letter Gothic 12, Gothic 17, and Trend Proportional Spaced. The AMT 250 comes with the IBM extended character set standard as well.

FACT FILE



AMT 250 Office Printer
Advanced Matrix Technology Inc.
1157 Tourmaline Dr.
Newbury Park, CA 91320
(805) 499-874
List Price: With serial or parallel interface only, $1,845; with both, $1,945.
Dimensions (HWD): 7 × 24.75 × 19 in.
Weight: 45 lbs.
In Short: An 18-pin wide-carriage dot matrix printer, this color-capable model offers top-quality features, 160-cps draft print, and superb letter quality. Moreover, it promises to hold up under rough treatment; expensive but worth every penny.

CIRCLE 623 ON READER SERVICE CARD

All fonts, emulations, and buffer memory are on ROM chips inserted in the logic board. The logic board is a full-sized interface board in the electronic chassis, a large bulbous unit that hangs on the back of the printer. A series of eight large chips in a row holds the printer driver, font, and RAM chips. Although 8K bytes of RAM are standard, you can increase the total to 40K by replacing other chips.

Chances are you will leave the memory as delivered, or if you alter the printer at all, you'll simply change or add emulations. Our review unit emulated the Diablo 630 and the Qume Sprint 11 in text mode and the Diablo, AMT, and IBM extended character graphics sets in graphics mode. You can just as easily specify Epson FX-80 or IBM Proprinter emulation instead of Diablo 630 and Qume emulation.

The AMT 250 has the usual complement of printer enhancements and formatting features, adding the somewhat unusual and welcome automatic centering and justification features as well.

You can control all the AMT 250's features through software that follows the conventions of the current emulation mode. The printer also has a fully functional front control panel and menu system, that you can use to set font, mode, self-test, print type, bail open and close, emulations, character slant, color, unidirectional or bidirectional print, perforation skipping, sheet-feeder hopper setting, language, pitch, form length, lines per inch, and paper path.

It's pretty easy to spend money equipping the AMT 250 printer. If you want both parallel and serial interfaces—the cheapest option—add another $100. Other options include a single-sheet drop-sheet-feeder for $195, a tractor-feed for $150, single-, dual-, and triple-bin sheet feeders for $295, $590, and $710, respectively, and sound hoods at $359 for a tractor-feed model and $489 for a sheet-feeder model.

A $595 full-sized board is an optional component. Called the plotter board, it uses its own processor to convert vector graphics signals to raster graphics signals compatible with the Houston Plotter or the Hewlett-Packard Graphics Language. It also includes a 512K printer-to-spooler buffer.

On a more pedestrian note, extra font ROMs cost $85 each. Currently 15 to 20 font ROMs are available. You can also download fonts to the logic board RAM.

While Advanced Matrix Technology offers the sound hoods mentioned above, the sound level stayed below 71 decibels in our tests.

What's special about the AMT 250 is its obvious design superiority and superb print quality. You can spend a lot less on a dot matrix printer, but you will get less than you get with the AMT 250. The heavy-duty printer even drew praise from another vendor's service technicians who were in PC Labs repairing printers while we were testing the AMT 250.

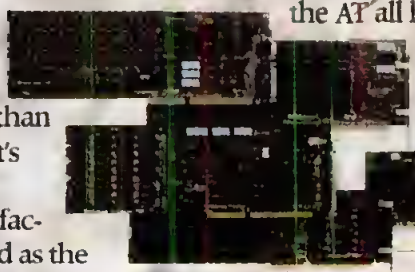
The AMT 250's only drawback is its price. If you looked for good deals, you could find a low-end laser printer and a medium-quality wide-carriage dot matrix printer for the price of a fully equipped AMT 250. But neither one could do what this beauty does.—**Bruce Brown**

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The C-715A Reliant 24-pin printer

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Identity Cards for transforming emulations give the Reliant the versatility to take care of all your office jobs



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CIRCLE 727 ON READER SERVICE CARD

Axonix ThinWrite 100

Grab your Axonix ThinWrite 100 and your battery pack and leave your power-supply worries on the doorstep. This friendly, reliable little 9-pin dot matrix from Axonix Corp. is always ready for action—whether it's running on battery power, recharging itself, or plugged into your car cigarette lighter. The $499 narrow-carriage portable printer will also accept current from so mundane a source as the wall outlet in your hotel room.

But plugging the ThinWrite 100 into the wall seems a waste of its high-priced talents (you can get the same printer, minus the battery power, for at least $200 less). The ThinWrite 100 without batteries is essentially the same machine as the Brother M-1109 and the Centronics GLP2, and it's exactly the same as the RCA VP2100, which we named as an Editor's Choice last year.

Like these other lightweight machines, the 6.5-pound ThinWrite 100 is easy to use, compatible with the IBM Proprinter and the Epson FX series, and produces acceptable draft and good near-letter-quality output for a printer its size. It even tested about 10 characters per second faster in draft—and slightly quieter—than the RCA model tested last year: 60-cps at a hushed 66 decibels, versus 51 cps at 71 decibels for the RCA. Still, the only reason to choose the $499 ThinWrite 100 over the $299 RCA VP2100 is portable power.

The printer has three power options. It can be plugged into AC current through the standard charger/adapter, can operate on batteries, and can run while recharging. Nickel cadmium batteries are already inside the printer when you receive it. To remove them, you must loosen four screws on the bottom of the printer.

The battery pack includes special General Electric matched cells with over 1,000 charge cycles. The printer can print about 100 pages per charge. The power light on the ThinWrite 100's front cover starts to flash when battery power is about half discharged. The charger/adapter recharges the batteries in about 12 hours, longer if the printer is operating during the recharging time. A replacement battery pack costs $35 from Axonix and its dealers.

Installing the ribbon and loading either cut-sheet forms or fanfold paper are fast and easy. The operation panel has four lights to keep you informed: power, check, on-line, and near-letter-quality. One of the two pressure-sensitive buttons toggles the printer on- and off-line. The other button switches near-letter-quality on and off when the printer is on-line and acts as a line-feed button when the printer is off-line. There's no form-feed; you simply hold down the line-feed until you reach the top of the form.

You can move from IBM mode to Epson mode by changing a DIP switch setting. The ThinWrite will produce 14 different character sets, all ASCII characters, and italic. Both draft and near-letter-quality are available in 5, 10, 12, and 17 pitch, with emphasized, double-strike, and underlined print as well as subscripts and superscripts. The printer can print bit-mapped image data in three print densities: standard, double, and quadruple. Four CRT-compatible densities are available for graphics. In addition, it can imprint checks and handle multipart forms.

The ThinWrite 100's battery-powered competitors are the much slower, much cheaper thermal Laptopp Systems' On the Go (reviewed in *PC Magazine*'s 1986 printer issue, Volume 5 Number 19), the somewhat less expensive Diconix 150 portable ink jet (also reviewed in Volume 5 Number 19), and the similarly priced Hewlett-Packard ink jet. With its primary competition coming from thermal and ink jet printers, Axonix made a wise decision in adapting the peripatetic RCA/Centronics/Brother dot matrix to battery power. And all the company had to do to the thorough, easy-to-follow manual was slap on an Axonix cover and add a few pages in the beginning about using AC/DC power.

Considering the $200 that the battery technology adds to the price of the machine, Axonix should throw in a carrying case free of charge. Then the ThinWrite 100 would have everything.

—Carol Olsen Day

Like other lightweight machines, the 6.5-pound ThinWrite 100 is easy to use, compatible with the IBM Proprinter and the Epson FX series, and produces acceptable draft and good near-letter-quality output for a printer its size.

FACT FILE



Axonix ThinWrite 100
Axonix Corp.
2257 South 1100 East, #2C
Salt Lake City, UT 84106
(801) 466-9797
List Price: $499
Dimensions (HWD): 2.6 × 13 × 7.5 in.
Weight: 6.5 lbs.
In Short: The portable, battery-powered version of a great little 60-cps 9-pin narrow-carriage dot matrix printer seen in many guises; it also runs on AC current.

CIRCLE 686 ON READER SERVICE CARD

Brother M-1709

Initially, the Brother M-1709 seems like just another competent dot matrix printer. But sound overall design, solid paper handling, and logical placement of controls and switches separate this $699 9-pin machine a bit from the competition.

Like many newer dot matrix printers in this price range, the Brother M-1709 offers paper parking, a feature that users could easily become addicted to. The printer backs fanfold paper out of the paper path and into standby position on the tractors to allow loading of cut sheets. That saves the

30 DAY MO

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1. Open the foldout page
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3. Slice the folded edge
4. Close the page and slip-sheet

GbsSlipSheet-001

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Inverted Back

GbsSlipBack-001B

Back

1. Follow instructions on the other side

NEY-BACK G

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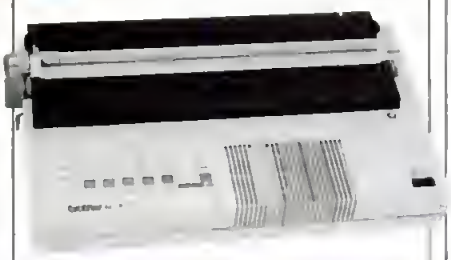
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PC MAGAZINE FACT FILE



Brother M-1709
Brother International
8 Corporate Pl.
Piscataway, NJ 08854
(800) 284-2844
(201) 981-0300
List Price: $699; optional add-in font card with three additional NLQ fonts, $74.95, add-in card with two additional fonts and 15K RAM buffer expansion memory, $99.95, optional cut-sheet-feeder, $149.
Dimensions (HWD): 4.9 × 19 × 11.25 in.
Weight: 18.75 lbs.
In Short: A well-designed, compact, wide-carriage 9-pin dot matrix printer with good paper-handling ability, it prints at 127 cps in draft.

CIRCLE **658** ON READER SERVICE CARD

annoyance and frustration of reloading continuous forms each time you finish printing on a single sheet. From the first time I tried it to the end of our tests, this feature worked beautifully.

The paper-loading routine also worked well. Paper is advanced cleanly and precisely to top-of-form after the tractors are snapped into place. Paper handling is clearly one of the Brother M-1709's strengths.

The printer's front panel is also well thought out and easy to use. Six microswitches control pitch, print quality, paper type, and paper advance. A pleasant surprise is the placement of the head gap adjustment knob. It is conveniently located on the outside of the cabinet near the platen knob instead of somewhere in the wilds of the carriage assembly. That's a definite boon to those users who often switch between single-thickness paper and multipart forms and need to adjust the printhead clearance accordingly.

You have the choice of using a parallel or a serial interface; both are standard.

Another plus is the compactness of the Brother M-1709. It accepts paper up to 16 inches wide, making it a true wide-carriage printer, but it measures a mere 4.9 by 19 by 11.25 inches (HWD). For users who have crowded desktops, that's an important consideration.

While the Brother M-1709's print quality is certainly acceptable, it is nothing to write home about. The resident Prestige typeface looks pretty good in near-letter-quality mode; the characters are fairly dark and smooth. But I've seen better in similarly priced machines.

Three additional NLQ typefaces are made available to the M-1709 through an add-in card that snaps into a single expansion slot, which is located under a cover mounted on the front panel of the printer.

The Anelia Proportional, Quadro, and Gothic typefaces are all attractive. I found it necessary when switching among them to return first to the printer's resident Courier font—a minor point, but somewhat annoying nevertheless.

The M-1709 moves along at 127 characters per second in draft mode. It's no speed demon, but that should be more than fast enough to handle most personal and medium-size office jobs. NLQ print speed is a fairly poky 34 cps.

As any versatile dot matrix should, the Brother M-1709 handles graphics emulation of the Epson FX-80 and the IBM Proprinter. It also emulates the Epson MX-80 and whips through the IBM higher-order character set.

I tried the optional cut-sheet-feeder and found it to be somewhat flimsy. Priced at $149, it has a tendency to deposit some sheets on the floor if left unattended.

The documentation that comes with the Brother M-1709 is a disservice to a quality product. It's not just the usual poorly translated English. (When will printer manufacturers write manuals—from scratch—in English?) There is no index, which is inexcusable, and the table of contents is, at best, sparse.

Poor documentation notwithstanding, the Brother M-1709's balance of features, compact size, and flexibility makes this printer worth considering for personal and light-to-medium business use.

—Jonathan Matzkin

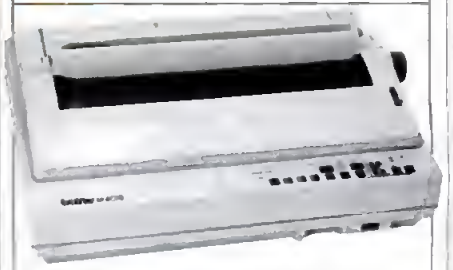
Brother M-4018

Brother International's $1,695 Brother M-4018 may not sport the dual dot matrix/daisy wheel technology of its sibling, the Brother Twinriter 6, but in many ways this dot matrix printer is much more versatile for business use. Like the Twinriter 6, the M-4018 prints well on multipart forms. But it also offers 18-pin printhead technology, a wide carriage, Epson and IBM emulations, and fast throughput—all at a reasonable price.

Installing the M-4018 requires little more than connecting cables and snapping in a ribbon cartridge. Operating the M-4018 is just as simple, since like many of today's printers, it has a front panel that controls virtually every feature you need. Not only does it have the now-standard line/form-feed, draft/letter quality, and pitch controls, it also gives you a touch-sensitive control for selecting fonts.

The built-in tractor is located beneath the rear cover, behind the cut-paper path. Its automatic-feed feature is one of the best you'll encounter. You simply slip the per-

PC MAGAZINE FACT FILE



Brother M-4018
Brother International
8 Corporate Pl.
Piscataway, NJ 08854
(800) 284-2844
(201) 981-0300
List Price: $1,695
Dimensions (HWD): 6.9 × 23.4 × 15.8 in.
Weight: 35 lbs.
In Short: An elegant, versatile 18-pin dot matrix printer, this wide-carriage machine offers fast draft (258 cps) as well as clear letter quality type and both Epson and IBM emulations. Another plus is the smooth-working built-in paper tractor.

CIRCLE **625** ON READER SERVICE CARD

forations onto the sprockets, close the clips and the cover, and turn on the printer. The paper automatically feeds through the path and to the top-of-form—no more wasting of sheets trying to set the top-of-form, no more folding the first sheet over to ensure that the paper goes around the platen and finds the sprockets. In operation, the tractor works so smoothly that once you feed in the initial sheet of continuous forms, you can—and probably will—forget that it exists.

Unfortunately, the optional tractor is not as elegant. Since its main purpose is for use with a bottom-fed paper path, and since Brother neglected to leave enough room between the bottom of the printer and the table surface, the optional tractor-feed requires a table with a slot for paper feeding. Attempting to use it on a normal desktop causes tension on the paper as it feeds—and eventually tears—along the perforations and the pin sprockets. Nevertheless, the optional tractor-feed is almost a necessity if you intend to print on multipart forms, because C-shaped paper paths in general tend to wrinkle and jam multiple-page forms.

The M-4018 comes with a number of built-in fonts, including Quadro and Prestige, and enhancements such as double-strike, and italic. You can access all the fonts, which cost $149 each, by using the IBM or Epson escape codes.

Although its design might not impress master typeface designers, the nearly sans-serif letter quality font is clean, legible, and corporate-looking. The well-formed characters show none of the occasional breaks or smudging that can occur with some dot matrix printers. The proportional spacing enhancement automatically includes boldfacing and can be used with italics, subscripts, and superscripts but not with condensed type.

The factory-rated speed for the draft mode is 400 characters per second; the PC Labs speed tests rated it at an impressive, legible 258 cps. Setting the printer to letter quality cuts the speed to a little more than 40 cps, which is probably a lot slower than you'd like. When printing on 80-column paper, the M-4018 produces 236 cps for draft and 39 cps for letter quality.

The manual (unlike that for the Twinriter 6) is well organized, written, and illustrated. It gives numerous examples of coding and cross-references the codes to other sections of the manual for additional information.

Brother International offers a number of options for the M-4018, including two cut-sheet-feeders, one of which has two paper bins as well as an envelope feeder. The vendor also sells another model of the M-4018 that's capable of color printing.

The M-4018 is an elegant dot matrix printer that just loves to output clean, legible documents in almost no time at all. Granted, it's not inexpensive, and its bell is more than a trifle loud. But if you're serious about having your work print out fast and look corporate, the versatile M-4018 may be the printer you've been waiting to requisition.—**Vincent Puglia**

Brother Twinriter 6

Brother International's Brother Twinriter 6 is the switch-hitter of printerdom, sporting both dot matrix and daisy wheel technologies within a unique design. Apart from giving you both graphics and letter quality text within the same document (a feat that is usually reserved for laser printers), the wide-carriage Twinriter 6 allows you to print on multipart forms (a task even the best laser printer cannot perform). And at $1,395, it is priced within the reach of businesses looking for a reliable, flexible printer.

The Twinriter 6 comes with Epson FX, IBM Graphics Printer, and Diablo 630 emulations. Its front panel sports touch-sensitive switches for mode, pitch, line spacing, top-of-form, and line-feed. While the 3K-byte built-in buffer is far from huge, it can speed the throughput of short documents such as invoices and bills of lading—a task at which the Twinriter 6 is a pro, since it can handle an original plus five copies. Also, the carriage spacer allows you to set the spacing between the carriage and the platen to accommodate envelopes. For users who have heavy-duty printing needs, Brother International offers an optional bidirectional tractor-feed as well as two optional sheet feeders.

The Twinriter 6's factory-rated speeds are rated at 200 characters per second for the dot matrix and 36 cps for the daisy wheel. According to the PC Labs speed tests, the actual throughput rates are 99 cps for the dot matrix head and 31 cps for the daisy wheel head. And, while the printer's sound level is relatively high (74 decibels), it's easily ignored—even in daisy wheel mode.

The automatic dual-bin sheet feeder we tested holds up to 125 sheets of 20-pound paper per bin. Although the feeder operated flawlessly, it displayed one drawback for speed freaks: the current sheet must completely clear the mechanism and fall into the out-bin before the next sheet is fed. While this method serves to prevent paper jams, it also drops the printer's throughput by 10 cps.

PRINT FEATURES The Twinriter 6's print features include proportional spacing, emphasized and double-strike enhancements, character pitches from 5 characters per inch to 16.7 cpi, underline, and subscripts and superscripts. All the enhancements are available through either Diablo or Epson escape code sequences. Since the graphics are compatible with Ep-

PC MAGAZINE FACT FILE



Brother Twinriter 6
Brother International
8 Corporate Pl.
Piscataway, NJ 08854
(800) 284-2844
(201) 981-0300
List Price: $1,395
Dimensions (HWD): 8 × 23.25 × 15 in.
Weight: 37.7 lbs.
In Short: The solution for printing graphics and letter quality text on multipart forms, this unusual wide-carriage printer combines dot matrix and daisy wheel technologies. It prints at 99 cps with the 9-pin dot matrix head and at 31 cps with the daisy wheel head.

CIRCLE 690 ON READER SERVICE CARD

For both dot matrix printing and daisy wheel printing, the Twinriter 6 has two modes of operation: draft and letter quality.

son FX and IBM Proprinter control code sequences, you should have no problems configuring the printer with your software.

For both dot matrix printing and daisy wheel printing, the Twinriter 6 has two modes of operations: draft and letter quality. That makes four major modes. The front panel displays labels for each mode, using both icons and abbreviations. Unfortunately, the abbreviations can be confusing since DP (draft processed) and WP (word processed) also suggests the print technology being used rather than a specific code sequence compatibility. You can also switch among any of the modes by using escape code sequences.

AUTOMATIC SWITCHING When you need to switch between letter quality daisy wheel mode and graphics mode, the Twinriter 6 does the switching automatically. Essentially, the printer can distinguish between the character ASCII codes and those assigned to graphics characters, and it relegates the printing to the appropriate print technology.

Because the Twinriter 6 uses a 9-pin matrix, the quality of the dot matrix output is a little grainy. The double-strike or emphasized enhancements fill the spaces in quite well but lower the print speed dramatically. The WP mode simply spaces the characters proportionally, without adding any more dots to the matrix. You'll need to use double-strike or emphasized print to produce correspondence or formal documents with the dot matrix technology.

Fortunately, the Twinriter 6 offers daisy wheel print technology to print letter-perfect documents. Its output is much as you would expect—excellent. The characters are all well defined, with crisp, distinct serifs. Unlike those in laser printer emulations, the bold and shadow enhancements are easily distinguishable. And because the daisy wheel mode uses Diablo 630 escape code sequences to access the enhancements, you can use it with most—if not all—word processing programs.

It doesn't take much longer to install the Twinriter 6 than it does to remove it from its packing—a few moments to connect the parallel cable (a serial interface is optional) and approximately 3 minutes to jockey the automatic dual-bin sheet feeder into position. The most difficult aspect is lifting the 37.7-pound Twinwriter 6 from the box.

Perhaps the worst aspect of the Twinriter 6 is its 65-page manual. It may be short and well organized, but the actual phraseology leaves much to be desired. In particular, its sketchy discussion of the print modes could use some examples and more explanation.

Aside from the lower cost of buying one printer instead of two, why should anyone buy a Twinriter 6 when any number of dot matrix and daisy wheel printers can offer better quality and speed? The answer is that the switch-hitting Twinriter 6 gives you the ability to mix graphics and letter quality print in the same document, as you can with a laser printer. And the Twinriter 6 goes one better than a laser printer, since it can handle multipart forms—its real advantage over a laser.

—Vincent Puglia

CIE TriPrinter CI3500 Model 20

The CIE TriPrinter CI3500 Model 20, from CIE Terminals (a C. Itoh Electronics company), is a wide-carriage 9-pin dot matrix printer that's built to take a licking and keep on printing. At $1,995, it demands to be taken seriously.

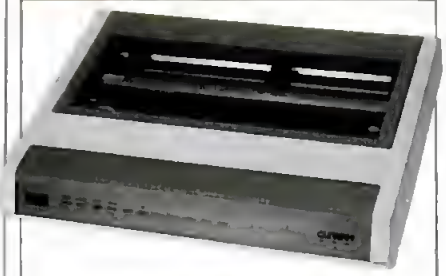
Designed to handle high-volume print jobs and built for endurance, the high-priced TriPrinter CI3500 uses a steel 9-pin printhead, which is good for about 500,000,000 characters, according to CIE Terminals. Also positioned as a bar code printer, the TriPrinter CI3500's fast speed in draft and its rugged construction confirm its suitability to this market niche.

The printer uses two types of plug-in cartridges: a font cartridge and an interface cartridge. The *tri* in TriPrinter indicates the three interface types: serial, parallel, and line. Model 20, the IBM PC version we tested, comes with a parallel interface, but an optional RS-232C serial interface cartridge is available for this model. The interface cartridge plugs into a socket inside the printer, and the cable from your computer connects to the cartridge through an opening in the rear of the printer. One font cartridge comes with each interface, or personality, cartridge.

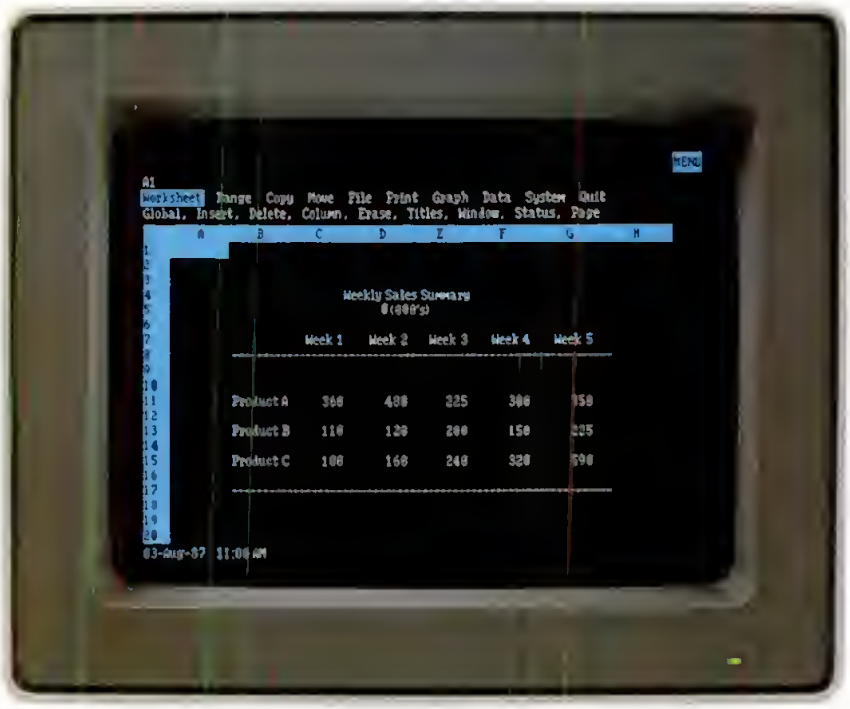
The TriPrinter CI3500 has numerous personalities, although its print styles are straightforward: draft and near-letter-quality in pica, elite, and condensed. The four available models, each with a different interface/personality cartridge, make it easy to adapt the machine for use with different hardware. Model 10 is DEC compatible; Model 20, IBM; Model 30, line printer; and Model 40, Apple ImageWriter. You can change from one model to another by switching cartridges, which sell for $165 each except for the line printer cartridge, which costs $245.

The user manual gives clear, step-by-step instructions for setting up the Tri-

FACT FILE



CIE TriPrinter CI3500 Model 20
CIE Terminals
2505 McCabe Way
Irvine, CA 92714-6297
(714) 660-1421
List Price: $1,995
Dimensions (HWD): 4.7 × 22.4 × 16.5 in.
Weight: 38.8 lbs.
In Short: A built-to-last 250-cps 9-pin wide-carriage dot matrix designed for heavy-duty print jobs. It comes with an equally heavy-duty price tag.
CIRCLE 808 ON READER SERVICE CARD



Quick–turn the page.

The TriPrinter CI3500 handles IBM block graphics with no problem, and you can download customized graphics and characters.

Printer CI3500. To avoid ink-smudged fingers, take the manual's advice and wear the gloves supplied for loading the ribbon cartridge. The trickiest part of loading the paper is manipulating the tractor mechanism, which has both top and bottom tractor gates. Paper loads from either the bottom or the rear of the printer. Loading the paper from the bottom, recommended for heavy, multipart forms, prohibits using reverse line-feeds and the optional tear bar.

With the top cover unhinged and latched in place, the most visible part of the TriPrinter CI3500 is its control panel, which extends across the sloping front of the printer. The panel has a three-digit LCD window on the left and 11 touch-sensitive buttons across the rest of the panel. The display window uses alphanumeric codes to provide status information, alarms, and test data. When you're using the buttons to set up the printer, the window indicates the existing settings and shows your changes as you make them. At first the display codes may seem confusing, but you can quickly decipher them after a little experimentation and by checking the manual.

The TriPrinter CI3500 has no DIP switches; the touch-sensitive buttons control all the functions. Seven of them—reset, mode, test, TOF (top-of-form), LF (line-feed), on-line, and enter—are operating controls that you use to change printer functions. You use the remaining four status control buttons—forms, font, CPI (characters per inch), and LPI (lines per inch)—when you want to check which settings the printer is using.

You can select any of ten international character sets as well as the two printer character sets from the front panel. You can quickly change from draft to NLQ in pica, elite, or compressed type. The NLQ print, produced with two passes of the printhead at about one-quarter the speed of draft, is acceptable—not a standard typewriter typeface but clear and crisp. You can see the nine distinct dots in the draft print, but it comes out of the TriPrinter CI3500 so fast—250 characters per second on wide paper—you won't mind. The top cover keeps the noise level down to a reasonable 72 decibels in NLQ and 74 decibels in draft.

The TriPrinter CI3500 handles IBM block graphics with no problem, and you can download customized graphics as well as customized characters. The printer also offers a timesaving way to print preprinted forms: it can store a list of preprogrammed vertical tabs that can be used on forms automatically.

Built to work long hours, fast at producing results, and receptive to your instructions, the TriPrinter CI3500 has a price commensurate with its tough all-business approach. Some 24-pin dot matrix printers may be cheaper than this rugged 9-pin machine. But if you fork over the $1,995 it costs, you'll no doubt give the stalwart TriPrinter CI3500 the toughest assignments on your roster of heavy-duty print jobs.
—Carol Olsen Day

Citizen Tribute 224

Toshiba America apparently has impressed a number of its competitors with its line of 24-pin dot matrix printers—so much so, that several vendors are manufacturing printers with Toshiba emulations in addition to the more-common Epson or IBM emulations. Citizen America Corp., for one, has introduced the Citizen Tribute 224, an excellent $949 office printer that emulates the Toshiba 1340, Diablo 630, and Qume Sprint 11 printers.

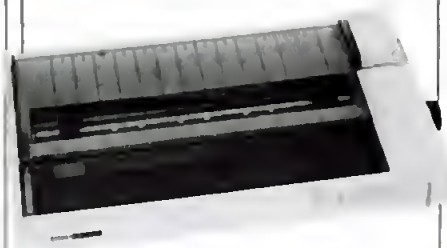
Unlike many of its peers, the wide-carriage Citizen Tribute 224 does not use touch-sensitive switches. Instead, depressible switches on its front panel let you choose type quality and font. There are also the usual line-feed/form-feed and on-line switches. I was delighted to find the DIP switches located in an easily accessible spot directly beneath the main switches. The DIP switches control default print quality as well as pitch, emulation mode, character set, and other functions. The printer comes with a serial port, which can be chosen by adjusting the DIP switches.

Users who want the Tribute 224 to emulate a printer other than the Toshiba 1340, Diablo 630, or Qume Sprint 11, or who want to use a font other than the printer's standard Courier 10 and Prestige Elite, can do so by inserting either an emulation card or a font card into a compartment on the top-right-hand side of the printer. Neither font card nor emulation card was available for review; both will be priced under $100, according to a Citizen America representative.

If only it were as easy to load paper into the Citizen Tribute 224 as it is to use its DIP switches! Although the printer's detachable sound cover, paper cutter, and paper guide work well in guiding the paper and preventing refeed, they interfere when you have to adjust or change the paper. Both the sound cover and the paper guide must be removed to reach the pin-feeds.

Once the paper has been fitted into the pin-feeds and brought manually toward the platen, the printer's self-feed mechanism automatically brings the paper around and

PC MAGAZINE FACT FILE



Citizen Tribute 224
Citizen America Corp.
2401 Colorado Ave., #190
Santa Monica, CA 90404
(213) 453-0614
List Price: $949
Dimensions (HWD): 4.5 × 23 × 14 in.
Weight: 16.53 lbs.
In Short: Using a Toshiba emulation to produce graphics, this easy-to-use wide-carriage 91 cps (draft), 116 cps (high-speed draft) 24-pin dot matrix printer produces high-quality draft, correspondence, along with letter quality output.

CIRCLE 667 ON READER SERVICE CARD



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Lotus Graphwriter II



Lotus Graphwriter II

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into position. The function works well, although I had to remove the printer cover before loading new paper to prevent it from getting caught beneath the cover.

The print quality produced by the Citizen Tribute 224 is impressive. Correspondence-quality output is a bit light, but is less jagged and uneven than that produced by many other printers. High-speed draft print has the zigzag quality typical of 24-pin printers. Letter quality output is excellent and approximates that produced by a typewriter. The curves of the letters are smooth. Draft and correspondence modes are available only in Courier; you can produce letter quality output in both Courier and elite.

What you get in print quality from the Citizen Tribute 224, you pay for in speed. Not one of the fastest printers on the market, the wide-carriage Tribute 224 prints at 56 characters per second in LQ mode, 91 cps in draft mode, and 116 cps in high-speed draft. In narrow-carriage draft mode, we clocked the printer at 91 cps. And at 75 decibels in high-speed draft, the printer is a little loud but the noise is not overly shrill.

The Citizen Tribute 224's two manuals are very well planned and written. A user manual tells you how to assemble the printer, as well as how to set its DIP switches. A reference manual describes the control codes and command sets; it also includes a handy control-code reference card.

Unfortunately, the PC Labs graphics emulation test did not include a Toshiba emulation. However, I was able to test the Tribute 224's graphics capability using EMUL3, a software utility from M.A.P. Systems (Houston, Texas) that allows Toshiba printers to emulate the printer commands and graphics modes of Epson machines. The resulting designs were sharp and in proportion.

In fact, the Tribute 224's only serious setback is its inclusion of a Toshiba emulation rather than an IBM or Epson emulation, which also means that the printer cannot produce high-order ASCII characters or true superscripts and subscripts. According to a Citizen spokesman, these limitations will be remedied with the production of its font cards. They certainly should not deter companies that are looking for a solid, well-planned business printer from seriously considering the Citizen Tribute 224.—**Barbara Krasnoff**

C. Itoh C-715A

The wide-carriage C. Itoh C-715A, from C. Itoh Digital Products, masters the possibilities. The $1,295 24-pin dot matrix printer uses credit-card-sized plastic identity cards to give you more choices, both in printing capabilities and in software programs. And it won't keep you waiting. The control panel's 16-character LCD instantly confirms your choices.

With four identity cards that plug into slots in its left side, the C-715A lets you choose among IBM Proprinter XL, Epson LQ-1000/LQ-1500, Toshiba P351, and Diablo 630 emulations. Additional cards are available for $49.95 each.

The C-715A's use of identity cards protects it from becoming obsolete; as new printers are introduced, all C. Itoh has to do is develop new identity cards. And inserting a card in a slot is certainly a great deal easier than installing an interface board or even changing the DIP switches.

But there's more to the C-715A than four emulations. Both serial and parallel interface connections, each with a 32K-byte buffer, are standard. Built into each identity card are draft and Courier near-letter-quality in 10 pitch (pica), 12 pitch (elite), 15 pitch, and 17 pitch (compressed), as well as proportional near-letter-quality fonts. You can also add fonts by using optional font cards, currently available in Letter Gothic 12 pitch and 15 pitch, Prestige Elite 12 pitch, and Bold Proportional Space 1 and 2. Each costs $39.95, and more are on the way.

Setting up and using the printer couldn't be much easier. In fact, unless you're a first-time printer user, you'll probably be able to use the quick setup method—ten fast, simple steps that take you from unpacking the printer to installing an identity card.

The state-of-the-art control panel, with its 16-character LCD, tells you what's going on, and you can also print a list of all the current options selected. In addition, four indicator lights—power, ready, LQ (letter quality), and quiet—are aligned above the on-line and LQ/quiet buttons to indicate the current status. The other four buttons are mode, set, LF (line-feed), and TOF (top-of-form)—all you need to program the printer for most jobs.

With the LQ/quiet button you can choose draft, letter quality, quiet letter quality, or quiet draft. The set button, helpful when you're using preprinted forms, enables you to adjust the alignment of the paper precisely.

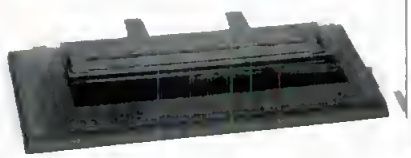
With the printer off-line, the set, line-feed, and top-of-form buttons take on another role. Along with the mode button, they activate changes in the control-panel menu.

The basic menu controls the nine functions that are changed most frequently, including font, characters per inch, page length, paper width. The extended menu lets you select options for 61 functions that are changed less frequently, among them ribbon color, buffer, slashed zero, and character set.

Each function has several options, and you can easily scroll through the menu's functions using the line-feed and top-of-form buttons. You can make changes to

EDITOR'S CHOICE

PC MAGAZINE FACT FILE





C. Itoh C-715A
C. Itoh Digital Products Inc.
1011 Francisco St.
Torrance, CA 90502
(800) 423-0300
(213) 327-5939
List Price: $1,295
Dimensions (HWD): 5.2 × 24.9 × 14.7 in.
Weight: 37.5 lbs.
In Short: A smooth-running 24-pin wide-carriage dot matrix that can change emulation identity in a flash; draft speed is a fast 145 cps, and changing options through the LCD front panel is a cinch.

CIRCLE 691 ON READER SERVICE CARD

the displayed options by using the set button. When you've made your adjustments to the options, you press the mode button to exit.

Print quality and speeds fulfill the promise of the high-tech controls. Clocked at 145 characters per second, the CI-715A's draft font looked clear and crisp. The LQ font rated a much slower 64-cps speed, but its print quality rivals that of a daisy wheel. And the standard 32K-byte buffer allows you to move on to other tasks quickly. The operating noise level seemed quieter than the 78-decibel draft and 79-decibel letter-quality sound readings indicated.

Besides user-defined characters, 18 international character sets are available. The printer will print high-order (ASCII code 128 to 255) characters but only if the IBM Proprinter XL or the Toshiba P351 identity card is installed. Graphics produced with the C-715A are precise, and 11 densities are available.

Other vendors should get a copy of the C-715A's user manual and applications manual to use as guides—they're that good. The applications manual includes a chapter on using the C-715A with nine popular software programs: *Microsoft Word*, Version 3.0; *WordStar*, Version 3.3; *WordStar 2000* and *2000 Plus*; *WordPerfect*, Version 4.1; Lotus's *1-2-3* Release 2; *SuperCalc4*; *Symphony*; and *Framework II*. It also includes guidelines for using the printer with other programs.

Companies that are as concerned about hardware and software adaptability, easy control of features, and versatility as they are about fast, professional-looking print will discover that the C. Itoh C-715A printer has it all. And with a fast change of identity cards, the C. Itoh C-715A brings you unlimited possibilities.

—Carol Olsen Day

C. Itoh C-815

Befitting its low-profile good looks, C. Itoh's C-815 printer offers an attractive combination: both high speed and good print quality. But as you might expect, this combination does not come cheap. With its price of just under $2,000, the 24-pin C. Itoh C-815 is for users who take their dot matrix printers seriously.

PC MAGAZINE FACT FILE



C. Itoh C-815
C. Itoh Digital Products Inc.
1011 Francisco St.
Torrance, CA 90502
(800) 423-0300
(213) 327-5939
List Price: $1,995
Dimensions (HWD): 5.75 × 22.75 × 15.5 in.
Weight: 33 lbs.
In Short: With measured speeds of 195 cps in standard draft and 285 cps in high-speed draft, the C. Itoh C-815 24-pin wide-carriage dot matrix printer offers not only impressive speed but also good print quality; proportional spacing and graphics, though, are less than ideal.

CIRCLE 679 ON READER SERVICE CARD

High price usually goes hand in hand with high speed, and the C-815's speed lets it compete with laser printers. In the PC Labs speed tests the printer clocked in at 96 characters per second in near-letter-quality mode and 195 cps in standard draft. When printing a double-spaced, letter-sized page, 195 cps translates to 8.3 seconds per page, or better than 7 pages per minute. The NLQ speed of 96 cps translates to about 17 seconds per page, or a still respectable 3.5 ppm.

The C-815 also has a special high-speed draft mode with a claimed speed of 570 cps. In the PC Labs speed tests, though, most dot matrix printers clock in at about half their claimed speed, and, true to form, the C-815 managed "only" 285 cps. For a double-spaced letter, this rate is equivalent to just under 6 seconds a page, or more than 10 ppm.

Unfortunately, the high-speed draft mode requires a clumsy setup procedure. You can set condensed mode to give either NLQ print or high-speed draft. But to change the setting, you must work your way through nested menus that you access with the printer's front-panel buttons. You can't access the high-speed draft mode by using software commands from the computer. What's missing from this scheme is an easy way to switch between the two modes. You'll probably find yourself making do without one of them.

The C-815 scores well on print quality. Text in NLQ mode approaches true letter quality, though a close look discloses the dot matrix source. Although the normal and the high-speed draft print look like dot matrix output, they're highly readable.

Alas, the C-815 has some minor print-quality problems, mostly when trying to produce combinations of enhancements. For example, when using the IBM Proprinter emulation, the C-815 will not switch to NLQ compressed text from 12 pitch. And changing to italic throws the printer back to 10 pitch.

The C-815's proportional printing is a also disappointing. Rather than changing to a font designed for proportional spacing, the printer keeps the standard Courier monospace font. Unfortunately, Courier is designed with wide lines at the base of the "i" and the "l," leaving little room to close up between characters. So you'll find it hard to detect the proportional spacing. True proportional fonts are available from an optional plug-in font card.

Graphics quality is also less than it might be. The C-815 passed the IBM Proprinter graphics emulation test with ease, but the solid black bars tend toward the gray part of the spectrum.

On the plus side, the C-815 has some helpful small touches. The printer cable, for example, goes into a recess in the back of the machine, where it's hidden by a plastic cover. The cable extends out through a hole at the left rear corner of the printer, where it's well out of the paper path. Also, the nested menus mentioned earlier work well for settings you don't want to change often. You can print a list of default settings by pressing the top-of-form button when you turn on the printer.

The C-815 has a more modern design and appearance than you might expect in a high-speed dot matrix printer. Weighing in at 33 pounds, it's far lighter than other printers in its category, some of which

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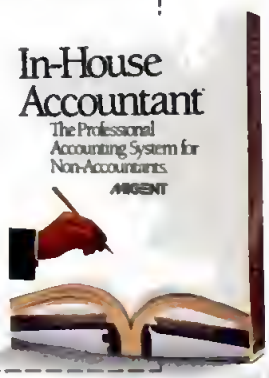
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weigh as much as 80 pounds. It's also relatively small for its class, more so than many daisy wheel printers.

Quiet operation is not one of the printer's strong points, however. The PC Labs sound level test measured 78 decibels in draft mode and 81 decibels in NLQ and high-speed draft. Fortunately, the pitch is low enough to make this sound a deep-throated roar rather than a high-pitched whine. The result is tolerable, if not ideal.

The generally well-written manual explains some of the control codes less clearly than it should. Good technical support from C. Itoh makes up for the limitations. When I ran into problems, a call to the company produced immediate and knowledgeable help.

If your budget can accommodate a printer in the $2,000 range, you may be considering buying a low-end laser printer. But if you need an impact dot matrix printer for multipart forms, labels, and envelopes, the C. Itoh C-815 can give you speed and text quality that approach what you'll get from a laser printer.

—M. David Stone

C. Itoh ProWriter C-310 CXP

C. Itoh's ProWriter C-310 CXP is a $749 lightweight, 80-column 9-pin dot matrix color printer. But it's got more than color going for it: it also offers IBM Proprinter—as well as Epson FX-80 Plus and JX-80—compatibility, the ability to print on single and multipart fanfold paper as well as cut sheet forms, both rear and bottom paper paths, and well-written, thorough documentation. The ProWriter C-310 also works with optional font cartridges and a sheet-feeder.

The ProWriter C-310 is one of a growing number of DIP-switchless printers; it relegates all the default settings normally associated with DIP switches to a ROM-generated menu.

The printer actually has two menus. The first one allows you to set the six most commonly used functions: emulation, form length, lines per inch, characters per inch, degree of printed quality, and the buzzer. The second menu gives you access to an additional 14 features, including slashed zero, various character sets, and recognition of the optional sheet feeder.

FACT FILE



C. Itoh ProWriter C-310 CXP
C. Itoh Digital Products Inc.
1011 Francisco St.
Torrance, CA 90502
(800) 423-0300
(213) 327-5939
List Price: $749
Dimensions (HWD): 4.5 × 16.25 × t3.5 in.
Weight: 20.9 lbs.
In Short: This excellent 80-column color printer has a 9-pin dot matrix printhead, allows rear and bottom paper paths, handles both Epson and IBM emulations, and operates at 177 cps in draft.

CIRCLE 652 ON READER SERVICE CARD

To use the menus, you hold down the LQ or the LQ and on-line switches on the touch-sensitive front-panel display while turning on the power. After the machine displays the current settings, you use the line-feed and top-of-form switches to cycle through the various functions and the on-line switch to select the option.

The built-in tractor is an elegant piece of engineering. It allows you either to push paper down into the platen or to pull it up over the platen. The pull technology enables you to feed multipart forms (an original and three copies) through the bottom, which avoids having the forms wrap around the platen—a path that would possibly cause wrinkles and paper jams.

Most people, though, would use the push technology exclusively for feeding continuous forms from the rear paper path. You can also feed individual sheets with the push technology by first backing the forms up to the tractor, lifting and propping the paper guide cover against the back, aligning the cut sheet behind the platen, and finally pulling the auto-load lever on the printer's left. Once you have finished with your cut sheets, you simply lower the cover and reload the continuous forms—no paper loss, no hassle.

While the ProWriter C-310's draft mode's quality is average for 9-pin printhead technology, you can easily distinguish such characters as 0 from O and 1 from l. And the printer's letter quality font is quite good-looking. A thin serif font that would grace almost any document, the letter quality font accepts many of the available enhancements, including double-strike and compressed and proportional print.

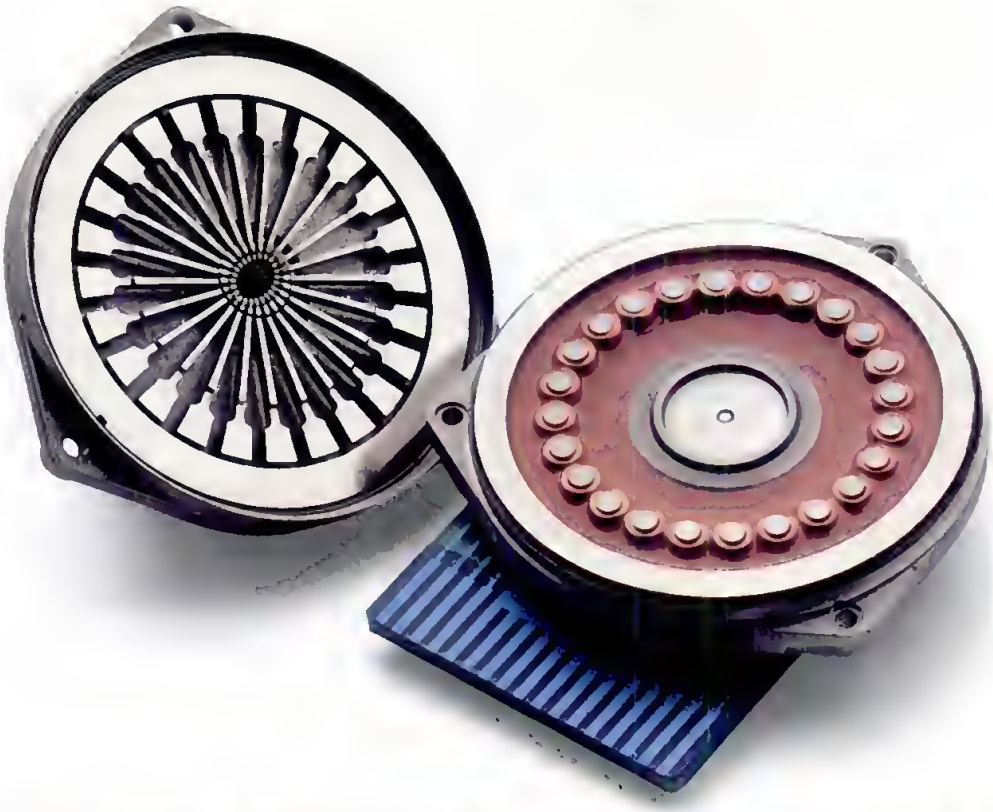
C. Itoh also offers optional font cartridges. The available fonts include italic, Letter Gothic, OCR-B, and Courier 10.

Besides having both Epson FX and IBM Proprinter emulation, the ProWriter C-310 CXP is capable of recognizing Epson JX-80 ribbon commands. In essence, this capability allows you to use any of the graphics programs that support the Epson JX commands. The quality of the graphics may not be as rich as you could get with a plotter, but it is quite acceptable for in-house reports. The ribbon itself has four colors: black, yellow, red, and blue.

The ProWriter C-310 passed the PC Labs emulation compatibility benchmark tests colorfully. When asked to print a graphic in Epson JX-80 emulation with text, black-and-white graphics, and various color bars, the printer produced output that had faint horizontal bands of white between the colors. These white traces can be attributed to the limitations of a 9-pin printhead.

The PC Labs speed tests showed that the ProWriter C-310's throughput is 177 characters per second in draft mode and 31 cps in letter quality mode. The factory-rated speeds are 300 cps in draft and 33 cps in letter quality.

Other vendors should use the ProWriter C-310 user manual as a model. Not only is it well organized and well written, but it is also informative and almost complete (lacking only a chart showing which enhancements are compatible with others). The manual tells you how to set up your printer and use its features—the absolute



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**Infoworld*, July 6, 1987

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minimum any manual should do—and it steps you through the printer configuration process for several programs. There are two quick-reference cards, one for each emulation, with escape codes and front-panel menu codes.

Even if you intend to use its color capability only occasionally, the C. Itoh ProWriter C-310 CXP is an excellent buy. Where else can you get a printer that is relatively fast, has a professional-looking letter-quality typeface, prints in color, and has a manual that is neither condescending nor overly technical—all for $749?
—Vincent Puglia

C. Itoh ProWriter jr. Plus

Small, light, and compact, the narrow-carriage 9-pin C. Itoh ProWriter jr. Plus, from C. Itoh Digital Products, seems to have the ideal characteristics to be a backup office printer. Usually such machines don't take up too much space and are relatively quiet, and although they don't have many features, those they do have tend to work well. However, the $369 ProWriter jr. Plus's slow print speed and limited font selections will probably disqualify it from most company's lists.

The switch panel, which is located on the right-hand side of the printer, has three buttons—on-line, form feed, and line-feed—as well as LCDs indicating on-line status, paper out, and power. The printer's DIP switches are in the back, next to the parallel connector; they are fairly accessible and can be used to switch the ProWriter jr. Plus from Epson- to IBM-compatibility modes. With one exception, all fonts and printing enhancements must be initiated by control codes; near-letter-quality mode is invoked by holding down the LF and on-line buttons while switching the printer on.

The manual is comprehensive and well illustrated; it does what it can to make things easy for the beginner.

Loading paper into the ProWriter jr. Plus is easy. Paper feeds through the front of the machine, where width labels have been placed to serve as a guide. Although the pin-feeds were loose and no screws were provided to tighten them, they held the paper steady without any problem through a few hours of testing. However, paper tended to bunch up underneath the plastic platen cover, and I frequently had to pull the paper taut through the back exit. Testing went a lot more smoothly after I had removed the cover.

Removing the cover didn't seem to affect the sound level much. With its cover in place, the ProWriter jr. Plus pounds away at 76 decibels in draft mode and is only slightly quieter at 74 decibels, in NLQ mode.

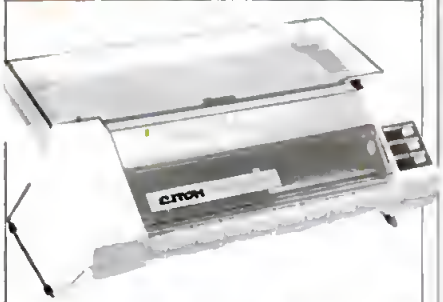
The print quality produced by the ProWriter jr. Plus is not impressive. The draft type is what you'd expect from this kind of printer: it's clear and readable but is obviously produced by a dot matrix printer. I was very disappointed with the NLQ type. Not only are the letters somewhat jagged and uneven, but C. Itoh has, for some reason, chosen a strange variation of the Courier typeface in which the "i" is at least a point size smaller than the rest of the type. In addition, letters having descenders—such as "y" and "g"—seem to float high on the line. The elite font is much cleaner, but it is not the default and must be invoked through your software. The printer had no trouble handling the PC Labs graphics test in either its Epson or IBM emulations.

> The narrow-carriage 9-pin C. Itoh ProWriter jr. Plus seems to have the ideal characteristics to be a backup office printer.

I was surprised to find that many ordinary enhancements, such as bold and italic, aren't available in NLQ type (although you can get bold through software). Since the draft type is definitely not suitable for business correspondence, the utility of the printer is considerably limited. What's more, the ProWriter jr. Plus is not even especially fast. In draft mode, we clocked the printer at 72 characters per second. But NLQ mode tested my patience as it chugged along at 20 cps. Never mind getting a cup of coffee while your printer works—the ProWriter jr. Plus will give you enough time to make a new pot.

A market definitely exists for good, inexpensive printers that do a simple job without fuss or bother. However, even at $369, the ProWriter jr. Plus has too many limitations to make the grade as a business printer.**—Barbara Krasnoff**

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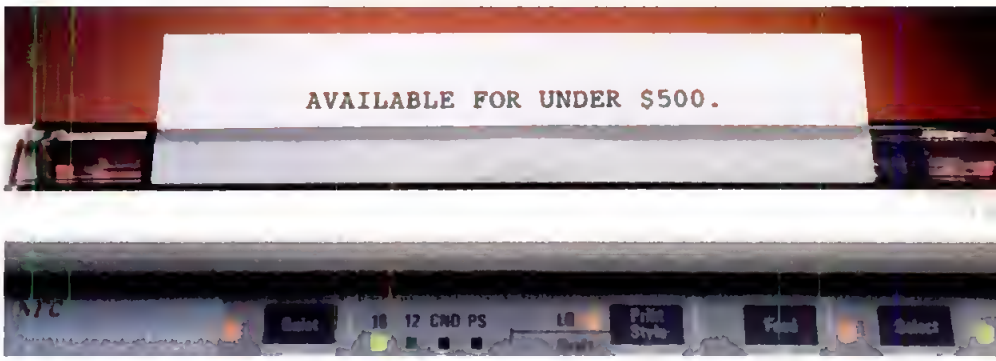
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C. Itoh Digital Products Inc.
1011 Francisco St.
Torrance, CA 90502
(800) 423-0300
(213) 327-5939
List Price: $369
Dimensions (HWD): 4 × 16 × 10 in.
Weight: 9.25 lbs.
In Short: This simple, lightweight 9-pin narrow-carriage dot matrix printer has too many disadvantages—a problematical NLQ typeface, extremely slow speed, (72 cps in draft), limited enhancement capabilities—to compete as a business printer.
CIRCLE 668 ON READER SERVICE CARD

Epson FX-86E and FX-286E

Epson America's FX-86E ($499) and Epson FX-286E ($699), narrow- and wide-carriage versions of the same 9-pin dot matrix printer, are the latest in the long line of Epson workhorse machines. In the tradition of the venerable Epson MX-80, they compete successfully in the most competitive niche of the PC product arena, the mid-range area of price, performance, and features. And they improve their distinguished lineage with enhanced performance and features.

IF THE REASON YOU HAVEN'T BOUGHT A 24-PIN PRINTER IS PRICE, YOU'VE LOST YOUR REASON.

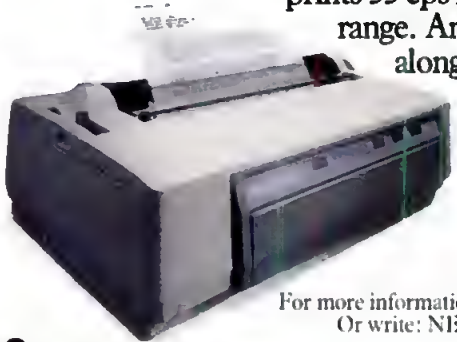
You've also lost your last reason for buying a 9-pin printer. Our new Pinwriter® P2200 dot matrix printer is the first 24-pin printer that is priced lower than many of today's 9-pin printers.



However, we didn't strip the price by doing the same thing to features. In fact, we gave the P2200 a few features you won't find on any other printers at any price.

Like more software support than any other 24-wire printer and unrivaled paper-handling capabilities. It feeds from both the rear and the front. And you can print a single sheet without removing your continuous paper. You can also produce up to 128 type variations within a single document.

We also didn't get the price down at the expense of speed. The P2200 prints 55 cps in LQ mode – that's faster than any other printer in its price range. And in draft mode, it speeds along at 170 cps.



So see your NEC dealer today. Anything else would be thoroughly unreasonable.

NEC PRINTERS. THEY ONLY STOP WHEN YOU WANT THEM TO.

NEC

For more information, and the name of the NECIS dealer nearest you, call 1-800-343-4418 (in MA 617-264-8635). Or write: NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

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"If you're an experienced computer user on a tight budget, the QIC 1800 is by far the best value ..considering the system's bargain—basement price I was more than a little surprised to find the operation manaual to be by far the best of the group."
Stan Miastkowski
BYTE, March 1987

System Configuration

	10 MHz	8 MHz
EGA System Basic system with option, EGA board and monitor	*$1629*	*$1584*
Monographic System Basic system with option Monographic board and monitor	*$1190*	*$995*
Color Syatem Basic system with option color board and monitor	*$1355*	*$1310*

QIC 286 System

Monitor not included.



QIC 6/8 MHz ***$756***
with option ***$1026***

QIC 6/8/10 MHz ***$799***
with option ***$1126***

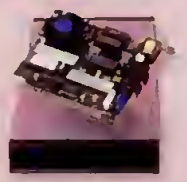
Basic System: 512K expandable to 1MB, two 8-bit and six 16-bit slots, clock/calendar with battery backup, 192 watt power supply, AT™ style keyboard, complete 200 page manual.

Option:
1 MB Floppy Drive
WD HD/Floppy Controller

Member of the Better Business Bureau.

High Performance, Capacity Drive for AT

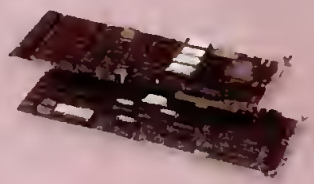
Seagate ST4038 30MB (40ms) ***$495***
Seagate ST251 40MB (1/2 Ht, 40ms) ***$535***
NEC D5146H 40MB (1/2 Ht, 40ms) .. ***$499***
Seagate ST4096 80MB (28ms) ***$875***



Hard Disk Kit for PC

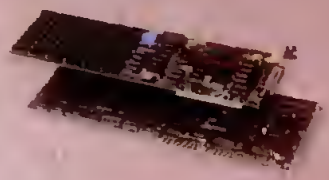
Quality HD Kit comes with controller, cable, manual, software and mounting screws.

Seagate ST225 (1/2 Ht., 65ms) ***$279***
Seagate ST238 (1/2 Ht., 65ma) ***$299***
Miniscribe SCXT30 Hard Card (65ms) ***$499***



Monitors

- **Monochrome** ***$109***
- **Color monitor** ***$295***
- **EGA monitor** ***$449***
- **NEC Multisync** ***$565***



Everex Modems

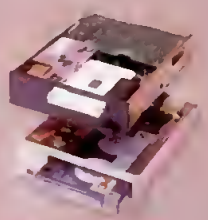
- **Everex Evercom 300/1200** ***CALL***
 1/2size, Hayes/Bell 103/212compatible, Bitcom software, made in USA.
- **Everex Evercom 1200/2400** ***$199***
 Same feature as above plus CCITT V.22 compatible.

- **External 300/1200** ***$119***
 Fully Hayes/Bell 103A, 212A and CCiTT V.22 compatible, LED status indicator.
- **External 1200/2400** ***$219***
 Same features as External 300/1200.



Graphics Board

- **QIC Micro EGA** ***$178***
 640 x 480, 16 colors EGA mode, 720 x 348 monochrome mode, 640 x 200 16 color RGB mode. Hercules 132 column.
- **QIC Monographic** ***$85***
 720 x 348, Hercules compatible, printer port.
- **QIC Monographic with 132 column** ***$109***
- **Profesional Graphic Adopter** ***$995***
 640 x 200, 2 colors CGA mode, mono Hercules mode 720 x 348, PGA mode 640 x 480, 256 color.



Memory/Multifunction Board

- **Memory board for AT** ***$155***
 0-3MB extended memory using 256K or 64K
- **AT Multifunction for AT** ***$148***
 Holds up to 2MB, parallel, serial and game port, set-up software.
- **XT EMS Multifunction** ***$159***
- **EMS board for XT** ***$99***
- **EMS board for AT** ***$139***
 Expandable up to 2MB, Lotus/Intel compatible.



Accelerator

(turbo board) ***$359***
Turns your PC/XT into 8 MHz AT, compatible with IBM PC and XT, 7 times faster than PC/XT, 33% faster than 6 MHz AT, 16 bit 80286 design.

Everex Tape Back-up

Back-up 20MB in less than 5 minutes, Image/File-by-file back-up and restore, window driven software, made in USA.

	External	Internal
60MB Cartridge	*$779*	*$759*
60 MB Cassette	*$690*	*$650*

Expansion Chassis *$429*

7 slots, no wait state design, 135 W power supply, room for 4 1/2 height drives.

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CIRCLE 122 ON READER SERVICE CARD

The speeds of the Epson FX-86E and the Epson FX-286E are right on the money for their price category: 129 characters per second in draft and 41 cps in near-letter-quality for the Epson FX-86E, and 138 cps in draft and 43 cps in NLQ for the Epson FX-286E.

Print quality itself has also improved for the FX series. Of course, these 9-pin printers can't produce results like those of 24-pin printers, and you can make out the dots in NLQ print—but only if you try.

By setting manual DIP switches on the back of the printer, you can select either IBM or Epson modes, in which case you will be hard pressed to find software that will not work with these printers. Epson FX-series printers are one of the few standards in the dot matrix world, and nearly all software supports them.

Both models come standard with friction feed and an external tractor unit. The tractor unit is much better than earlier Epson pin-feed mechanisms. Loading paper is foolproof, and you no longer waste a sheet of paper every time you start or finish a printing job.

If you have the desk space to accommodate it, the wider Epson FX-286E affords greater flexibility for reports and spreadsheets, as well as the ability to print mailing labels four to a sheet.

The Epson FX-86E and FX-286E come with a draft typeface and an NLQ typeface with Roman and sans serif fonts. To switch between draft and NLQ modes and between normal and condensed type, all you do is push the proper buttons on the control panel, called the SelecType menu. Software control codes override SelecType settings.

You can also use software to control other printing characteristics, including bold, underline, italic, double-strike, superscripts and subscripts, automatic centering and justification, double-high and double-wide characters, horizontal and vertical tabs, variable form length and line height, and proportional spacing.

One characteristic of the printers that Epson America could improve in future versions is noise level. Both printers scored 73 to 78 decibels. Although the sound isn't particularly grating, it leaves room for improvement.

Both models come standard with a parallel printer interface and an 8K data buffer. Optional interfaces include several types of serial interface as well as larger data buffers, to a maximum of 128K.

Printers in this price category are primarily designed and marketed to single users who have light- to medium-duty print runs and who print everything from drafts to correspondence-quality letters, and from charts and graphs to mailing labels. If you fit that profile, you'll want to see what the Epson FX-86E and the Epson FX-286E can do.

Essentially, these printers are great if you need more performance, durability, and features than you get with the lowest-priced printers, but can get by with 9-pin print quality. Continuing the Epson tradition of excellence, they're sturdy, reliable printers with creditable performance and unmatched software compatibility.

—Bruce Brown

PC MAGAZINE FACT FILE



Epson FX-86E and FX-286E
Epson America Inc.
2780 Lomita Blvd.
Torrance, CA 90505
(800) 421-5426
(213) 539-9140
List Price: Epson FX-86E, $499; Epson FX-286E, $699.
Dimensions (HWD): Epson FX-86E, 5.5 × 16.5 × 15 in.; Epson FX-286E, 5.5 × 21.5 × 15 in
Weight: Epson FX-86E, 16.9 lbs.; Epson FX-286E, 22.2 lbs
In Short: The narrow- and wide-carriage versions of this 9-pin dot matrix model print draft at 129 cps and 138 cps, respectively. They continue the tradition of Epson's legendary series, adding an extra internal font and front-panel menu selection.

CIRCLE 550 ON READER SERVICE CARD

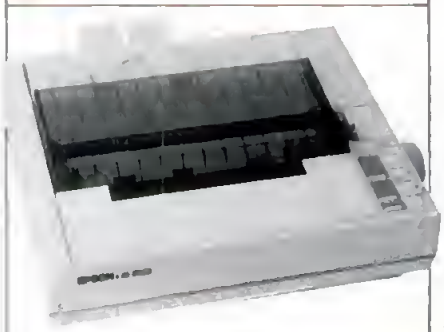
Epson LQ-850 and LQ-1050

Narrow- and wide-carriage versions of the same Epson America 24-pin dot matrix printer, the $799 Epson LQ-850 and $1,099 Epson LQ-1050 are the latest incarnations of two of last year's Editor's Choices, the LQ-800 and LQ-1000.

The rage in dot matrix printers is currently the print quality many manufacturers obtain by using 24-pin printheads. Epson America attracted a lot of attention with the 24-pin LQ-1500 in 1984, and its 24-pin printers have been front-runners since. Last year the low-priced machines in the series, the LQ-800 and the LQ-1000, were elected Editor's Choices because of their type quality and features for their price level. The LQ-850 and the LQ-1050 are even better.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Epson LQ-850 and LQ-1050
Epson America Inc.
2780 Lomita Blvd.
Torrance, CA 90505
(800) 421-5426
(213) 539-9140
List Price: LQ-850, $799; LQ-1050, $1,099.
Dimensions (HWD): LQ-850 5.5 × 17.5 × 16 in; LQ-1050, 5.5 × 24.25 × 16.5 in.
Weight: LQ-850, 19.8 lbs; LQ-1050, 26.4 lbs.
In Short: This 24-pin dot matrix printer, in both narrow- and wide-carriage versions, is a terrific deal, with fast (153 cps) draft and excellent letter quality, full compatibility with the Epson LQ-1500 and the IBM Proprinter, and the latest advances in convenience and control features.

CIRCLE 626 ON READER SERVICE CARD

Both the 80-column LQ-850 and the 132-column LQ-1050 print draft mode on letter-sized paper at 153 characters per second. The LQ-850 prints letter quality type at 67 cps; the LQ-1050, at 68 cps. The wide-carriage LQ-1050 can print at 163 cps on wide paper. These speeds are nothing to sneeze at, especially for printers in this price category.

Epson equips most of its printers with a front-panel control feature called SelecType. The buttons on the top of the LQ-850 and the LQ-1050 let you choose the font, the pitch, and condensed mode.

Of course, speed should be the second half of the story with any printer whose model number starts with LQ. Both the LQ-850 and the LQ-1050 deliver the print quality we've come to expect from the Epson LQ series. Draft quality is clean and neat, and letter quality is exceptionally good. Although not as impressive as that of the superb LQ-2500, Epson's highest-priced 24-pin printer, the best print of the LQ-850 and the LQ-1050 will certainly serve most office needs.

Both models offer all the formatting and print enhancement features you'd expect: boldface, underline, double-strike, double-high, and double-wide characters; italic, compressed print, superscripts and subscripts; automatic centering, automatic justification, proportional spacing, horizontal and vertical tabs, and variable form length and line height.

Standard features include draft and both roman and sans serif letter quality fonts. Two easily accessed font cartridge ports on the right of the printer hold optional $59.95 cartridges.

Epson equips most of its printers with a front-panel control feature called SelecType. You can use this feature to select various print settings, which vary from model to model. The buttons on the top of the LQ-850 and the LQ-1050 let you choose font, pitch, and condensed mode. The font-selection control also has lights that indicate use of two optional fonts, which work only if cartridges are inserted. The machines include other "intelligent" menu characteristics as well. For example, you cannot set the pitch to PS (proportional spacing) and turn on condensed mode at the same time. Condensed mode overrides proportional spacing.

Both models bang away with their 24 pins, scoring 72 decibels on our sound level test. The noise isn't bad, but there's something magic about dot matrix printers that are quieter than 70 decibels.

One of the niftiest features of this new printer is the auto-load paper device. To load paper, all you have to do is to put the top of the first sheet of continuous-form paper in the tractor and hit the load button. The paper comes forward right to the top of the printhead.

Many printers have an auto-load feature, but where the LQ-850 and the LQ-1050 leave most of their competitors behind is what happens after you load continuous-form paper. If you then want to load single-sheet paper, you can do it without much fuss. You simply hit the load button with paper in place (and with the paper-feed lever in the continuous-form position), and the printer retracts the paper almost all the way. You can then print on single sheets without wasting continuous-form paper and your time.

When you want to resume continuous-form printing, you simply hit the load button, and the printer reloads the paper so you can proceed. Only a few other printers do this trick to date.

The LQ-850 and the LQ-1050 emulate both the Epson LQ-1500 and the IBM Proprinter. You can select emulation through software or by changing one rear-mounted DIP switch.

When it comes to dot matrix performance for the dollar, it's hard to beat the LQ-850 and the LQ-1050. The print is good-looking and fast, and the convenience features are valuable perks. Why spend more for printers that can do only slightly better when you can have the high-quality LQ-850 and LQ-1050 without the high cost?—**Bruce Brown**

Epson LQ-2500

The Epson LQ-2500 is the latest in Epson America's line of 24-pin wide-carriage dot matrix printers. This new unit includes five letter-quality fonts, a front-panel LCD menu system called SelecType, and the ability to create macro settings that retain four different sets of printer configuration codes. The $1,399 Epson LQ-2500 is not the fastest dot matrix printer on the market, but its print quality competes with everything shy of laser printers.

Unfortunately, the LQ-2500 has to spend a lot of time banging away to make its lovely characters. The highest tested speed I could wring from our review unit was 133 characters per second in draft mode. Bear in mind, however, that the LQ-2500's draft mode is very, very good. Perhaps more significant is the 67 cps I obtained in letter quality mode. Quite often printers that fly while creating only acceptable draft quality slow down to below 30 cps in highest quality. The LQ-2500 is clearly designed to deliver lots of crisp

PC MAGAZINE FACT FILE



Epson LQ-2500
Epson America Inc.
2780 Lomita Blvd.
Torrance, CA 90505
(800) 421-5426
(213) 539-9140
List Price: $1,399
Dimensions (HWD): 5.75 × 24 × 16.5 in.
Weight: 26.4 lbs.
In Short: The 24-pin wide-carriage LQ-2500 is Epson's highest-quality, most fully featured dot matrix printer. Although it yields 133 cps in draft mode, the emphasis is on NLQ printing with five built-in letter quality fonts.

CIRCLE 621 ON READER SERVICE CARD

(continues)

"If understanding your business is more important than just calculating numbers... you need  ."

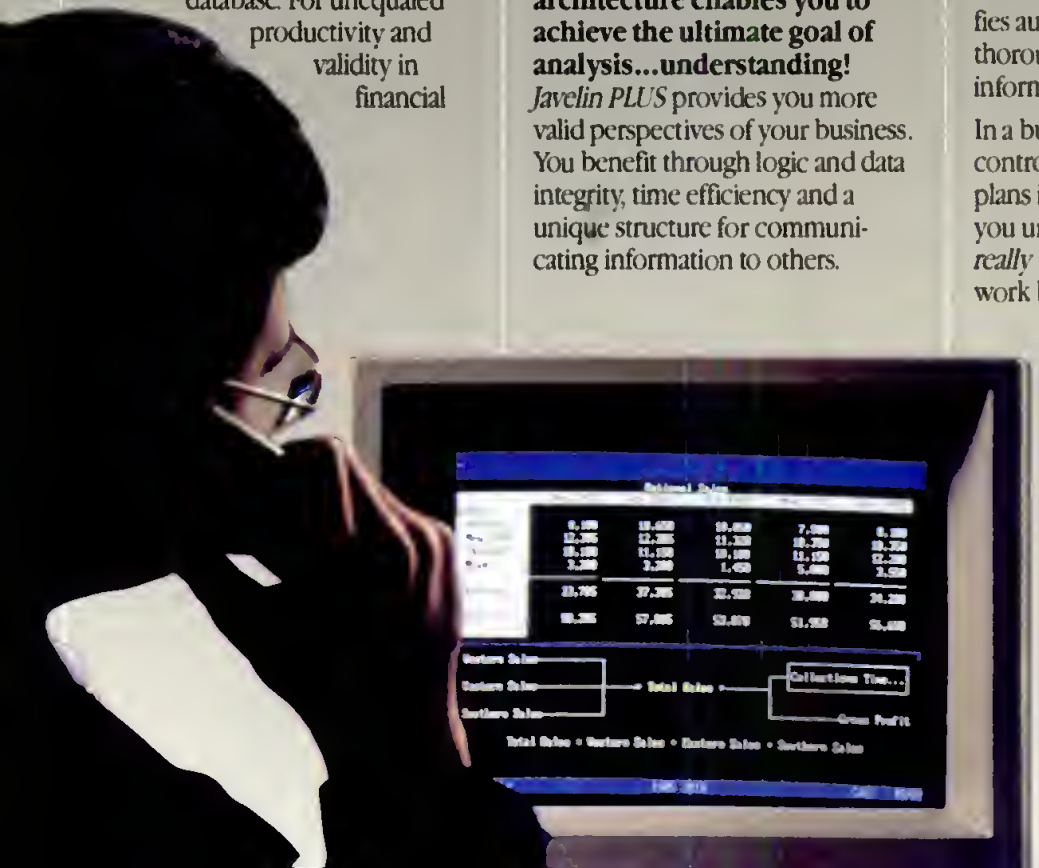
Numbers by themselves mean nothing... understanding your numbers and being able to communicate their significance to others can mean *everything*.

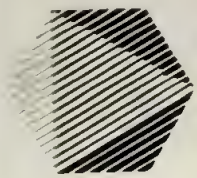
Javelin PLUS™ brings numbers to life with the best features of both a spreadsheet and an analytic database. For unequaled productivity and validity in financial and marketing analysis, budgeting, planning, and reporting, *Javelin PLUS* helps you understand which of your business variables are most important...how they relate to each other...and helps you share the significance of these variables with other people.

Javelin PLUS' unique architecture enables you to achieve the ultimate goal of analysis...understanding! *Javelin PLUS* provides you more valid perspectives of your business. You benefit through logic and data integrity, time efficiency and a unique structure for communicating information to others.

These qualities are made possible by a central information base that stores data, logic, English variable names and notes...accessed by ten views that let you review and manipulate information in whatever way is, at the moment, appropriate to your analysis. *Javelin PLUS* automatically self-documents your model and clarifies audit trails so you can be thoroughly confident in your information.

In a business world where your control over information and plans is critical, *Javelin PLUS* helps you understand how numbers *really* work...and how they'll work best for you.





Javelin

"If you can't afford to make mistakes... you need Javelin PLUS."



***Javelin PLUS*™ brings you the best way to deal with errors... by keeping them from happening in the first place!**

It's never pleasant to talk about errors. They cost money...and jobs. But the fact remains that many spreadsheets contain serious errors. Even a *Lotus* magazine article states that 30% of all spreadsheets contain difficult-to-trace flaws. *Javelin PLUS*' unique features, such as Formulas, Notes and Errors views, are designed to avoid such pitfalls and to pinpoint errors when they occur.

For example:

- *Javelin PLUS*' clear audit trails significantly reduce the chance that logic can be lost or broken.



- Numbers, formulas, and assumption notes are dynamically linked to English variable names — not cryptically coded cell locations — so that all changes are global and rearrangements can be made easily.
- The efficiency of *Javelin PLUS* reduces total analysis time — increasing productivity. That means less chance of error caused by fatigue, and more opportunity for group discussions of computed information.

Javelin PLUS helps you manage the risks of a model's growing complexity.

Many models start out quick and dirty but soon take on larger more complex proportions. With added complexity comes frustration and errors due to the practical limitations of conventional spreadsheet software. *Javelin PLUS* solves these problems by eliminating the confusion and potential dangers of tedious cell manipulations. You can handle simple and routine tasks quickly and master the intricacies of large models...all with the confidence of *Javelin PLUS* safeguards.

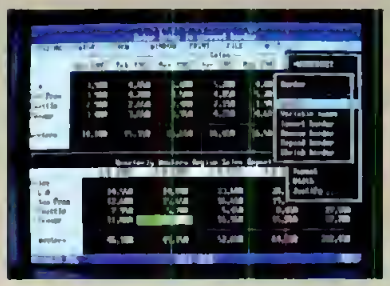
Javelin

"If time is critical to you... you need Javelin PLUS."

If there's no time like the present, why does everyone need everything yesterday? *Javelin PLUS*™ does the job right the first time. Jobs that took hours or days with conventional spreadsheet software now take minutes!

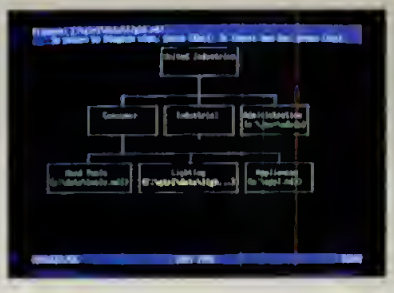
Here's how Javelin PLUS saves you time...and increases productivity!

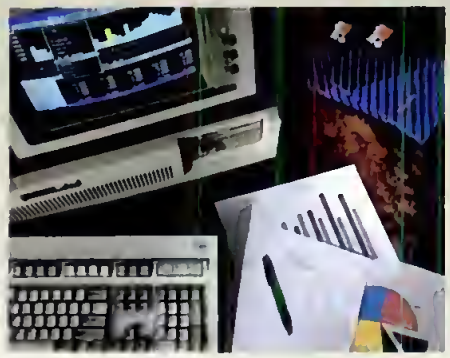
• *Javelin PLUS lets you make as many worksheets (spreadsheets) as*



you want and they are all automatically linked. You enter data only once. *Javelin PLUS*' central information base links *ALL* numbers, text data, dates, relationships, graphs, notes, as well as worksheets, making manipulations easy. This permits remarkably quick report generation and lets you rearrange the layout of your worksheets without altering logic or losing information. Worksheets can be as large or as focused as you need and are flexible for anything from quick and dirty jobs to formal reports for giant models.

• *Automatic consolidations of data.* Without building new logic, *Javelin PLUS* can quickly consolidate files...and you don't need to match rows and columns!





• *Javelin PLUS understands time.* A built-in calendar handles fiscal and calendar years, and can convert data between years, quarters, months, weeks, and days. For example, your budget may be in months — *Javelin PLUS* automatically sums the data from months into quarters.

• *Interactive graphics* give you the unique ability to change your numbers by moving bars or lines. For example, you can draw a graph to create data for a forecast — the numbers go into the central information base and can be used anywhere in your model.

• *Javelin PLUS lets you use the same software for both modeling and database operations on text and dates as well as numbers.* Now you can effortlessly combine, compare, sort, and cross tab information any way you like.



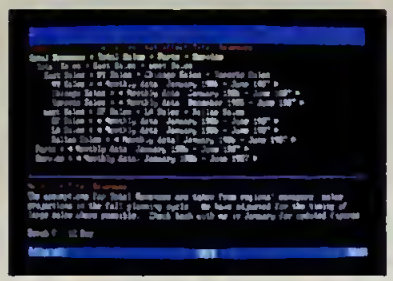
When time moves more quickly than your current system for analyzing information...you need *Javelin PLUS!*

Javelin

"If you need to communicate your work to other people... you need Javelin PLUS."

Analysis is often a group process. *Javelin PLUS*™ gives you the tools to present and justify data that can be easily understood.

Automatic, clear audit trails result in easy explanation of models.
Javelin PLUS creates clear audit trails *automatically*. No conventional spreadsheet package provides convenient and effective documentation of logic and assumptions behind business models.



Javelin PLUS provides flexible data exchange with other Javelin PLUS users as well as with conventional spreadsheets.
Javelin PLUS allows users to import or export data, worksheets, macros, or entire models. This flexibility helps you share everything you want to...or *only* what you want to. Libraries of models can be reliably, easily and automatically interlinked. *Javelin PLUS* understands ASCII, WKS, WK1, WRK, DIF, and SYLK data, as well as PIC and PostScript™ graphics file formats. You are in control with *Javelin PLUS*.

Javelin PLUS spans networks.
Javelin PLUS utilizes local area network (LAN) power, including Novell's® Advanced NetWare,™ 3Com's® EtherShare™ and 3PLUS,™ and IBM's Token Ring. Not only can you import and export data across these networks, but Javelin's SPELL key lets you look into the contents of other Javelin models and helps guide you through DOS directories and path names.

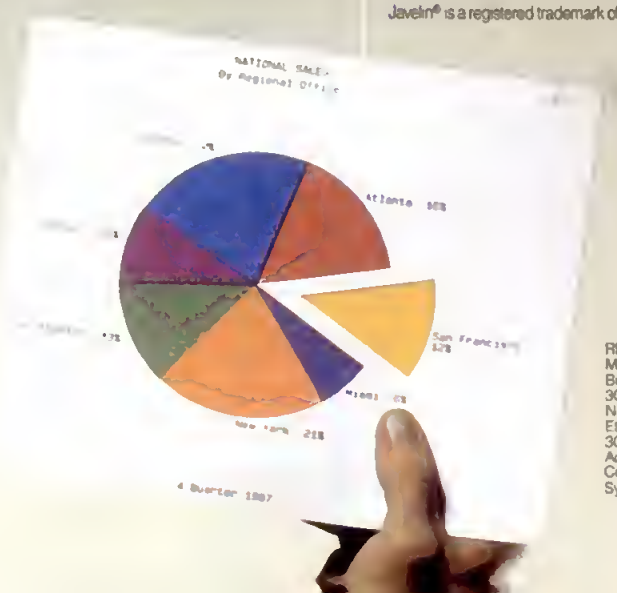
"This product is much better than I can possibly describe.

You've got to see it to believe it." Bill Machrone
Publisher and Editor-in-Chief
PC Magazine

Javelin

Javelin Software Corporation
One Kendall Square, Building 200
Cambridge, MA 02139
1-800-JAVELIN
(617) 494-1400

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Javelin PLUS system requirements:
IBM PC, XT, AT, PS/2, Compaq, and 100% compatibles • 512K of memory • Two floppy disk drives or one hard disk (recommended) • DOS 2.1 or later version

Additional support:
IBM Monochrome, CGA, EGA, MCGA, VGA graphics adapters • Hercules Graphics Card • Wide variety of printers and plotters • 8087 and 80287 math co-processors • Memory cards supporting Expanded Memory Specification (EMS) including: Intel, AST, Orchid, Thesys.

REGISTERED TRADE MARKS IBM International Business Machines Corp 3Com 3Com Corp Novell Novell Corp TRADEMARKS EtherShare and 3PLUS 3Com Corp Novell Advanced NetWare Novell Corp PostScript Adobe Systems, Inc

near letter-quality dot matrix print at relatively rapid speeds.

Speed isn't all this machine offers. The LQ-2500 comes with an impressive selection of five letter-quality fonts, including Epson copyright Roman, Sans Serif, Courier, Prestige Elite, and Script typefaces. ɔmbined with the usual selection of print ʻhancement and formatting features, the Q-2500's many font options give you a eat deal of control over the design of ur output.

The SelecType fonts and the features u system give you a lot of control over rinter, but I found the system some- ifficult to use. The way you get into lecType menu is to take the printer .e and then hit the line-feed and ped buttons at the same time. This s simple, but in practice I found it hit them exactly at the same time. sult I would often cause a line-feed -feed to occur.

e you do get into the menu system an select print quality, font, pitch, ensed type, form length, perforation , left and right margins, graphics char- ter sets, language, single or bidirectional inting, half-speed, and optional sheet- eder control.

One of the most impressive features of e LQ-2500 is its ability to use what Ep- n calls macros for separate printer con- ol configuration sets. The four factory settings for macros include one for draft printing, another for letter quality printing, a third for wide spreadsheet printing with condensed print that allows up to 233 columns across a page, and the fourth for printing graphics. You can customize any of the macro settings, as well as set and save four macros. While many beginning users might avoid using the macros because it seems a bit hard at first, the actual time saved should make up for the time invested in learning how to use them.

The LQ-2500 makes a fair amount of noise. It registered 79 decibels in both draft and NLQ modes. While that level isn't enough to chase you out of the room, long runs could be objectionable without an acoustic enclosure.

The typically good Epson documentation includes sections on setting up and using the printer, SelecType, command summary, and reference listings. There is also a quick-reference card that includes a command menu map and a glossary.

Besides emulating the rest of the Epson LQ linc, the LQ-2500 also can be set to emulate the IBM Proprinter.

If your primary need is letter quality print but you have occasional need for graphics and high-speed draft printing as well, the LQ-2500 offers exceptional print quality and very respectable speed. This machine is justly Epson's dot matrix flagship.—**Bruce Brown**

Epson LX-800

At $299, the Epson LX-800 dot matrix printer is Epson America's entry-level model, intended for first-time buyers. The best news about the 9-pin LX-800 is the functions and the performance you get for price: draft and near-letter-quality print, character and graphics compatibility with the IBM Proprinter, and the usual range of print enhancements.

The LX-800 prints at 105 characters per second in draft mode and 27 cps in NLQ mode. These speeds are not earthshaking, but when you consider that they are tested speeds and not manufacturer-rated speeds—and remember what the printer costs—the LX-800 is quite a deal.

The LX-800's printhead uses 9 pins to print characters and graphics. Usually, 9-pin heads can't produce characters as full and clear as those produced by 18- or 24-pin heads, and the LX-800 bears out the generalization. Yet the draft type is certainly acceptable, and the NLQ type compares well with that of printers that cost twice this price 3 or 4 years ago.

The 80-column LX-800 has both friction-feed and an internal tractor-feed. Both of these paper-feeding mechanisms work smoothly.

The printer is light (11 pounds) and takes up little desk space. Its small size and weight make it convenient to move around, but the disadvantage of its largely plastic construction is the impression it gives that it won't stand up to a lot of abuse. Clearly, the LX-800 is not intended for heavy-duty printing.

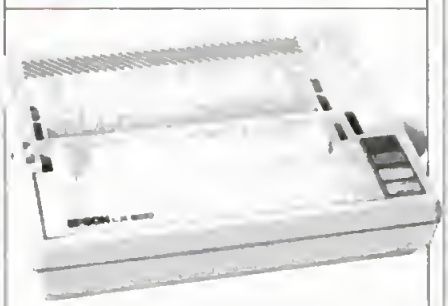
Besides draft and NLQ, the LX-800 can produce emphasized (bold), double-strike, condensed, italic, and double-wide print. It can also print superscripts and subscripts. No extra fonts are available, although you can define your own characters and symbols using software. The LX-800 successfully prints the IBM high-order character set.

The LX-800 is fairly noisy, another drawback of the lightweight case. It registers 79 decibels in draft mode and 78 decibels in NLQ. But since the printer probably won't be used much for long print jobs, the noise level is only a minor concern.

Setting up the LX-800 is easy, especially if you've installed a printer before. The familiar ribbon cartridge slips into place easily, and loading the paper is straightforward as well.

Novice computer users who buy this printer will enjoy one of Epson's most welcome contributions: complete and clear documentation. The manual includes step-by-step installation information, tips on using the LX-800 with different types of applications programs, and reference information on how to use all the features. Appendixes include a command summary, character set tables, a problem-solving

PC MAGAZINE FACT FILE



Epson LX-800
Epson America Inc.
2780 Lomita Blvd.
Torrance, CA 90505
(800) 421-5426
(213) 539-9140
List Price: $299
Dimensions (HWD): 3.58 × 15.7 × 12.1 in.
Weight: 11.2 lbs.
In Short: This narrow-carriage 9-pin dot matrix printer offers a combination of speed (105 cps in draft), print quality, compatibility (IBM Proprinter), and features; it's good as a first or backup printer.

CIRCLE 483 ON READER SERVICE CARD

and maintenance section, and additional setup and interface information.

In this day of high-powered printers that try to do everything better than everyone else, there's still a place for low-end printers like the LX-800. This segment of the market is price driven, which clearly benefits the most common purchasers of these printers: beginning users. For a mere $269, beginners with the Epson LX-800 can do most of what the more experienced users with their high-speed 24-pin printers can do. And they can rest assured that their software will work with the printer, since Epson printers are one of the few standards in the PC market.

Another possible role for the LX-800 is as a spare printer for the busy office or professional practice that needs an extra printer occasionally or as a backup in case the more expensive printers fail.

The inexpensive LX-800 serves as a good example of how far the performance-to-price ratio has improved in the past few years. As a first or backup printer, it's all that you need and want.—**Bruce Brown**

Facit B3100 and B3150

Students of printer aesthetics take note: the Facit B3100 and its wide-carriage version, the Facit B3150, are a cool shade of gray. But more than the color of the case distinguishes these boxy yet sophisticated 9-pin dot matrix printers, which are priced from $695 for the narrow-carriage black version to $965 for the wide-carriage color and long-life black-ribbon versions.

Targeted at PC, LAN, and supermicro users by Facit, a company that has been manufacturing typewriters since 1890, these heavy-duty printers offer three emulation modes: IBM Proprinter, Epson FX/JX, and Facit. Both serial and parallel interfaces are standard. And the built-in Soft Setup is a welcome, easy-to-use replacement for awkward DIP switches and certain control codes.

The quadrilingual (English, French, German, and Swedish) user manual relies on illustrations, with no labels, more than on words. In fact, it includes 20 illustrations on loading fanfold tear-off paper alone.

Loading paper from the bottom or the rear of the printer goes without a hitch. The large platen knob on the outer right side of the printers makes adjusting the paper easy, unlike the corrugated, hard-to-turn knobs on some machines.

The too-concise manual is more informative about the Swedish word for printer (*scrivaren*) than it is about how to produce bold type or print using different colors. Of course, you can rely on your applications program to produce special effects like boldface, underline, and italic. Or, as suggested in the user manual, you can request the programming manual from your Facit representative. Considering the intended market and the price of these printers, Facit should include the programming information with the printers in the first place.

Admittedly, the Facit B3100 and B3150 control panels make certain control codes as passé as last year's brat pack. The control panel has three parts: a dial and two sets of buttons and indicator lights, banked vertically. A transparent plastic shield slides over the setup buttons when you're not using them, prohibiting anything from interfering with your setup.

You simply adjust the dial to get draft in 10 pitch, 12 pitch, 15 pitch, 17 pitch, and proportional spacing, and near-letter-quality in 10 pitch, 12 pitch, and proportional spacing. Under the dial, along the top bank of buttons and lights, are the power light, the low-noise button and light, the on/off-line button and light, the line-feed/park button, and the form-feed/load button.

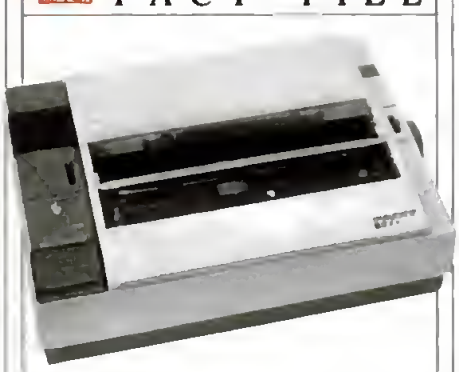
The bottom bank of buttons initiates and controls the Soft Setup, an easy method for choosing emulation mode, interface, ribbon color, character set, paper type, page format, and more. The Progr Set Up light indicates that the setup procedure, which you initiate by pressing the enter/yes button, is in progress.

All instructions appear in English unless you equip your printer with an optional French, German, or Swedish installation card that plugs into a slot in the upper-left-hand side of the printer. Another plug-in slot accepts a font card. Currently, Letter Gothic, Prestige Elite, OCR-A, and OCR-B font cards are available and more are in the offing, according to the vendor.

The Facit B3100 and B3150 main menus include the following categories: print current values, printer command mode, general, paper and format, communication, and default. You use the no button to position the printhead over the category of values you wish to change. The printer then prints a series of yes or no questions for each menu category. The printer can also store these values for use in subsequent printing sessions.

PRINT QUALITY Draft-quality print is what you'd expect for a 9-pin dot matrix, but draft bold and even compressed are quite good-looking. Near-letter-quality print almost defies you to distinguish it from daisy wheel output. Graphics produced on the Facit B3100 and B3150 are precise but not particularly intense. Color printing is intense—and elusive, unless you consult the by-request-only programming manual. The printers can produce all the high-order characters, and you can download customized characters with the

FACT FILE



Facit B3100 and B3150
Facit Inc.
9 Executive Park Dr.
Merrimack, NH 03054
(603) 424-8000
List Price: B3100 (narrow carriage), $695; color version, $815. B3150 (wide carriage), $895; color and long-life black-ribbon versions, $965.
Dimensions (HWD): B3100, 5 .66 × 18.5 × 16.75 in.; B3150, 5.66 × 24.5 × 15.75 in.
Weight: B3100, 24 lbs.; B3150, 33 lbs.
In Short: A 9-pin dot matrix that prints 154 cps draft in wide-carriage and 149 cps draft in narrow carriage but is regrettably slow in near-letter-quality mode. Both versions are distinguished by an easy-to-use setup procedure.

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The Facit B3350 is a fairly fast printer, clocking in at 136 characters per second in draft mode and 75 cps in near-letter-quality.

help of the programming manual.

Print speeds fall off dramatically in NLQ. Rates for the wide-carriage B3150 were 154 characters per second in draft and 44 cps in NLQ. The narrow-carriage B3100 tested at 149 cps in draft and 41 in NLQ. Both machines hum along at 69 decibels in NLQ and 71 decibels in draft; selecting the low-noise option reduces the sound to 66 decibels but slows the printers' speed. With these ratings, the Facit B3100 and B3150 improve on their older sibling, the Facit 4513, reviewed last year—and they have no DIP switches to set.

Whether you call the Facit B3100 and B3150 *scrivarens*, *Druckers*, *imprimantes*, or simply printers, they are sturdy, versatile machines distinguished by their easy method for setting up print values. With improved NLQ speeds and a more complete manual, they'd be better able to show their true colors.

—Carol Olsen Day

Facit B3350

The $995 Facit B3350 is a powerful 18-pin dot matrix printer with a menu selection facility that should earn the neatest-trick-of-the-year award. It's a fairly fast printer, too, clocking in at 136 characters per second in draft mode and 75 cps in near-letter-quality.

Like many high-quality dot matrix printers, the Facit B3350 sports user-programmable switches rather than DIP switches. The printer's two-section control panel includes standard function keys, such as those for on/off-line, line-feed, and form-feed, as well as a dial for selecting print quality: NLQ mode in proportional spacing, 12 pitch, or 10 pitch; or draft mode in proportional spacing, 10 pitch, 12 pitch, 15 pitch, or 17 pitch.

Besides those control-panel options, the Facit B3350 has a low-noise switch, which forces the printhead to move unidirectionally across the page. The low-noise switch may not be the answer to noise pollution, but it reduces the sound level from 76 to 71 decibels in draft and from 75 to 73 decibels in NLQ. Located above the Facit B3350's control panel are two slots and a storage area for font cards.

Programming the Facit B3350 is easy and fast even on the first try. You can program the printer to emulate the IBM Proprinter and Epson FX/JX printers as well as select the ribbon color, character set, slashed zero, paper format, and communication set. To change any of these functions, you turn on the printer while simultaneously holding down the enter/yes button.

The Facit B3350 prints out six categories of programmable selections, including print current values, paper and format, printer command mode, communication, general, and default. You can also print a set of programming instructions before you begin to program the printer.

To choose a setting, you press the no button, which causes the printhead to "point" to one of the printed titles. When you reach the category you want to look at, you hit the yes button. Doing so gives you a second list of category or mode choices, which you choose in the same way.

To finish the process, you press the exit button. The printer then asks if you want to store the values even after the power is off. The default mode will reactivate the printer's factory settings, bypassing any previous programming you may have done.

You can install forms in several different ways, depending on the type of paper you have. Not only are there separate pull settings for form-feed paper and single sheets, but there are two separate push tractor-feed positions for continuous or tear-off feed paper. It's a bit difficult to load paper into the Facit B3350 because the printer's main paper feed is hard to get to. But once the paper is loaded, it scrolls through the machine without a problem. In addition, you can load paper through the bottom of the printer.

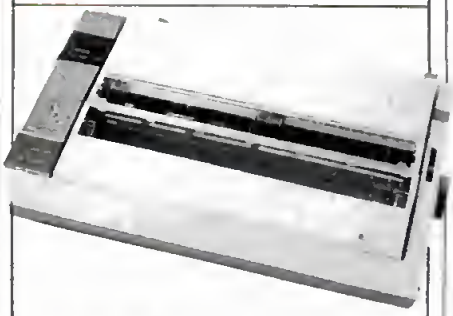
The Facit B3350's hinged printhead cover, which is attached to the machine, slips down over the front of the printer and remains out of the way. The back cover can be removed or will stand on its hinge if necessary.

The Facit B3350 can accept color ribbons; it does as good a job of printing in color as any dot matrix printer. Color ribbons, which come in red, yellow, and blue, cost $24.75 each. A long-life black ribbon, which is good for 10 million characters, costs $25.

The sans serif and Courier typefaces for draft and NLQ modes are a little too squared off for my taste; both reminded me that I was reading text printed by a printer rather than by a typewriter. Output from both draft and NLQ modes falls into the category of good but not great. In NLQ, the edges of the letters are slightly ragged, and the descender of the letter "g" starts descending above the line. The Facit B3350 had no problem passing the PC Labs graphics test: it produced clear, detailed patterns.

A good bet for many offices, the Facit B3350 is well-planned, speedy, and easy to program, and has a useful quiet mode. It may be only a matter of aesthetics, but I would suggest that users for whom top-

PC MAGAZINE FACT FILE



Facit B3350
Facit Inc.
9 Executive Park Dr.
Merrimack, NH 03054
(603) 424-8000
List Price: $995 ; $1,040 (color).
Dimensions (HWD): 5.5 × 23.75 × 15.5 in.
Weight: 33.1 lbs.
In Short: This 136-cps 18-pin wide-carriage dot matrix printer has an innovative and easy-to-use programming panel, but its print quality is only adequate.

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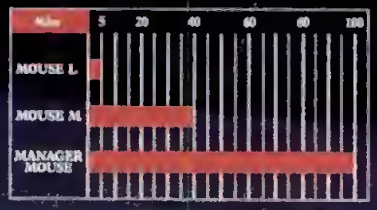
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quality output is crucial take a close look at the Facit B3350's squared-off typefaces before plunging in.—**Barbara Krasnoff**

Fortis DM1310

Fortis Information Systems' $299 Fortis DM1310 is a prime example of the new crop of low-end dot matrix printers. Like a number of other inexpensive printers now on the market, it offers what was until a short time ago available only in printers that cost twice as much.

A lightweight (14.5 pounds), narrow-carriage, 9-pin dot matrix machine, the Fortis DM1310 is compatible with both the Epson FX-100 and the IBM Graphics Printer. The 25-cps near-letter-quality type that it prints in both Epson and IBM modes is strong and barely discernible as dot matrix output.

The printer produces pica and elite fonts fluidly and enhances them well. It easily incorporates boldface, underlining, italic, proportional spacing, and shadow print, as well as subscripts and superscripts.

Moreover, when emulating either the Epson or the IBM printer, the Fortis DM1310 prints graphics that, although a bit too splotchy to be called high quality, surpass those printed by typical low-end dot matrix printers. The geometric shapes, lines of differing widths and complexity, and intricate patterns that it creates have sharp, distinctive outlines and components.

One drawback to the Fortis DM1310 is the way it requires you to load paper. Apparently the Fortis engineers, for some unexplainable reason, decided to come up with a new tractor-feed design. The tractor pins face into the guts of the printer; nearly inaccessible, they are located underneath the platen. Because of this design, not only is the instruction manual's explanation of how to load paper a convoluted mishmash, but installing paper can be trying.

First, you must line up the tractor pins with preset marks on the printer. Then you must rotate the tractor frame to align a groove in it with the tractor bottom. Finally, you have to roll the paper into the printer until it catches the tractor pins behind the platen—a process that takes place out of view. You can only hope that the pins grab the paper correctly.

The printer's speed is definitely more typical than remarkable. On the PC Labs speed tests, it printed 93 characters per second in draft and only 25 cps in NLQ. Fortis rates the printer at 130 cps in draft and 33 cps in NLQ.

The Fortis DM1310 instruction manual is an easy-to-understand document that could serve as a model for other manufacturers. Though the manual is short, it's clearly the result of a great deal of thought and care. It concisely describes how to get the printer up and running immediately.

Unlike discussions of control codes in manuals that assume a higher level of competence than many users have developed, the control code section explains what control codes are and why and how to use them. Only then does it define, explain, and illustrate each code. Extremely useful sample BASIC programs follow, showing how to embed the control codes in software. In addition, the last pages of the manual include a complete list of all the commands.

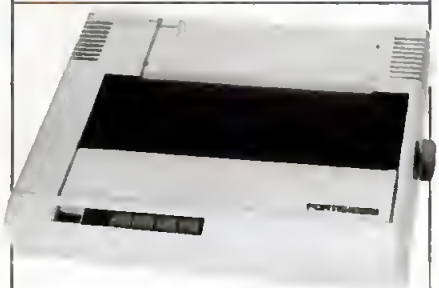
Fortis has reason to be proud of this printer, and of its knowledgeable, helpful technical-support staff. If you're looking for a low-end, narrow-carriage printer that offers some of features and performance of printers that not long ago cost $500 and up, the Fortis DM 1310 is a good place to start. —**Jeffrey Rothfeder**

Fujitsu DL2600

Fujitsu America's top-of-the-line printer, the wide-carriage, 24-pin Fujitsu DL2600 dot matrix machine, is both imposing in size and rugged in appearance. The printer gives the impression that it could print all day long, but it's more than a workhorse—it's also sophisticated.

Although Fujitsu sells the $1,495 DL2600 as a high-speed printer, the machine is not as fast or as expensive as some others in the high-speed class (the CIE Tri-Printer, for example). But its rapid draft speed of 170 characters per second in wide-carriage format produces superior draft print. At 78 cps, the near-letter-quality mode that Fujitsu prefers to call "letter

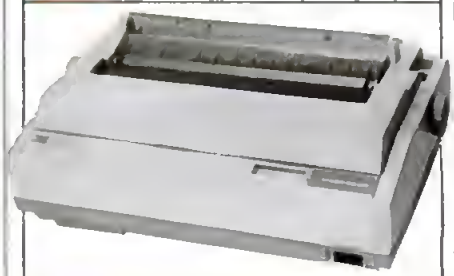
PC MAGAZINE FACT FILE



Fortis DM1310
Fortis Information Systems Inc
6070 Rickenbacker Rd.
Commerce, CA 90040
(213) 727-1227
List Price: $299
Dimensions (HWD): 3.6 × 16.7 × 13.6 in.
Weight: 14.5 lbs.
In Short: A narrow-carriage 9-pin dot matrix model that prints 93 cps, this inexpensive printer offers many of the features of machines that cost well above its price.

CIRCLE **635** ON READER SERVICE CARD

PC MAGAZINE FACT FILE



Fujitsu DL2600
Fujitsu America Inc.
3055 Orchard Dr.
San Jose, CA 95134-2017
(408) 432-1300
List Price: With both serial and parallel interfaces standard, $1,495; color option, $200.
Dimensions (HWD): 9 × 24 × 18.5 in.
Weight: 44 lbs.
In Short: The DL2600 is Fujitsu's heavy hitter—a sturdy, 170-cps, 24-pin wide-carriage dot matrix printer that produces beautiful type from both built-in and cartridge fonts, selectable with its front-panel LCD feature menu.

CIRCLE **677** ON READER SERVICE CARD

At last getting organized is painless with Nutshell Plus



In the past, when choosing a database, you had to sacrifice ease of use for power, and flexibility for programming skills.

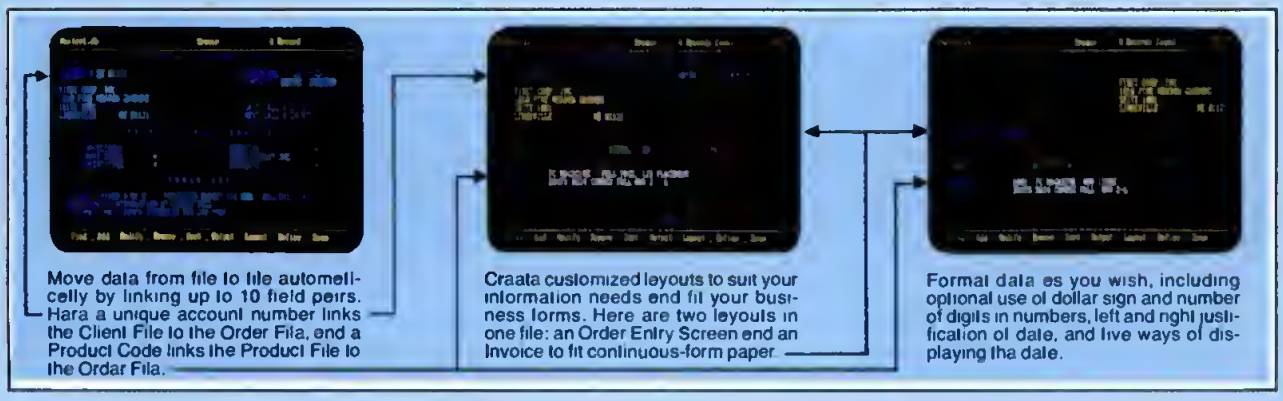
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Move data from file to file automatically by linking up to 10 field pairs. Have a unique account number links the Client File to the Order File, and a Product Code links the Product File to the Order File.

Create customized layouts to suit your information needs and fit your business forms. Here are two layouts in one file: an Order Entry Screen and an Invoice to fit continuous-form paper.

Format data as you wish, including optional use of dollar sign and number of digits in numbers, left and right justification of data, and five ways of displaying the date.

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- Print to screen to preview the exact appearance of your data
- Insert the current date and time with one keystroke
- Change field type
- Eliminate empty space between and within records when printing
- Preset data to avoid rekeying of repetitive data
- Use the exponentiation operator in calculation formulas
- Read files you created with Nutshell, its flat-file cousin

Visit your nearest retail dealer and try the ***Nutshell Plus*** Guided Tour Disk, then buy ***Nutshell Plus.*** At $295 we think you'll find a lot to like.

For the name of your nearest dealer carrying ***Nutshell Plus,*** call the Canterbury International Sales Office at 1-800-637-8385 (outside of Massachusetts) or (617) 881-7404 in state.

Nutshell Plus runs on the IBM and IBM-compatible PC, XT, AT, and PS/2s. It requires 384K and DOS 2.0 or higher. Nutshell is a registered trademark of Nashoba Systems, Inc.

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The Printer Muffler 80, pictured above, fits most standard-carriage dot-matrix printers, and the Printer Muffler 132 fits most wide-carriage dot-matrix printers.*



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CIRCLE 272 ON READER SERVICE CARD

quality" is one of the fastest dot matrix NLQs we found.

Designed to meet most word processing, data processing, and graphics needs, the DL2600 can emulate the IBM Graphics Printer and the Epson FX-80 for text and graphics. If you buy the color kit—a $200 option—the DL2600 will also emulate Epson JX-80 medium- and high-resolution printing and produce seven different colors from a four-color ribbon.

You probably can't expect dot matrix print any better than the levels available from the Fujitsu DL2600; it produces excellent print. The letters in the Fujitsu letter quality mode are fully formed and filled in. The draft mode and an in-between mode called the "report" are appropriate for internal documents and reports and for casual correspondence.

The printer's built-in fonts are Courier 10, Prestige Elite, and Bold Face Proportional. The DL2600 also uses optional, $45 front-loading font cartridges that each supply one font. We tried both the Light Italic and Orator fonts, the latter a favorite for speakers' notes with its large, clear print. Other fonts now available from Fujitsu include Letter Gothic 12 and Scientific 12. Orator and the included standard fonts would most likely take care of your printing needs nicely.

The DL2600 is a little noisier than Fujitsu's other printers, reaching 71 decibels, but the sound is acceptable. The unit's low-noise print mechanism, integral acoustic cover, and padding work to keep the volume low.

The printer's harmonica-style ribbon cartridge comes packed with plastic gloves, but don't be misled—the cartridge installs hitch-free. Another nice feature is the push-pull bidirectional tractor.

The high-powered machine has a 16-character LCD menu on the front panel. This type of menu presentation and selection system is more sophisticated than the type that some printers (like the DL2600's sibling, the Fujitsu DL3400) print on paper. With the printer off-line, you can use the menu to set all printer parameters, including fonts. To access the fonts from the features menu, you must run the menu SETUP operation first (it's clearly outlined in the good—but not great—unindexed manual).

The control panel menu gives you access to your choice of print quality, character style, character spacing, line spacing, language, and interface type, as well as protocol settings if you are using the printer's serial interface. Both parallel and serial interfaces are standard on the Fujitsu DL2600—a convenient feature for a printer that might well become an office workhorse, moving among several computers with various available interface ports.

Adding to this heavyweight's role as a sole office performer is the availability of single-bin, double-bin, and double-bin with envelope-bin sheet feeders, available for $495, $695, and $900 respectively. As desirable as the feeding units are, they're priced a bit high for a printer in this price range.

The Fujitsu DL2600 can stand particularly good stead as an office's sole printer, used to print reports and correspondence, mailing labels up to four across, and Epson- and IBM-compatible graphics, even in optional color. It's also a good alternative as a network server printer, especially for the times when a laser printer isn't a wise choice because of software, graphics, or color requirements. Even though its cost can exceed $2,000 if you add accessories like a sheet feeder and extra fonts, the Fujitsu DL2600 delivers a lot of power for the dollar.—**Bruce Brown**

Fujitsu DL3400

At $995, the Fujitsu DL3400, a 24-pin wide-carriage dot matrix printer, is positioned as a low-cost entry machine to high-end contemporary dot matrix printing. Many users will find that it delivers the right selection of features for the price. Its only drawback is its slightly confusing features menu.

The Fujitsu DL3400 has draft, near-letter-quality, and high-speed-draft modes. At about 143 characters per second, regular draft is noticeably better than that produced by 9-pin printheads. If, however, you're willing to put up with a less dense print high-speed draft mode buzzes right along at 170 cps. NLQ mode produces beautiful, quality print at a very respectable 59 cps—one of the fastest performances in its price range.

Probably few observers would believe that the print from the Fujitsu DL3400 came from a laser printer, but they might have to look carefully to determine that it didn't. The print quality is good, especially with the two extra fonts included with the printer. Besides the normal NLQ, draft, high-speed-draft, and condensed modes, the printer offers both Courier 10 and Prestige Elite fonts in NLQ mode. Extra fonts are available from Fujitsu and cost $45 for two fonts, which come on small interface cards that slide into the machine.

The noise level of the DL3400 is acceptable; it buzzes away just at or under 70 decibels.

Some of its nifty design features reveal the Fujitsu DL3400's heritage. Yet some of its characteristics—those associated with feature and mode selection—still need design work. They're either confusing or take too much effort to use.

On the plus side, the top and front covers are hinged and attached to the machine so that you never have to remove them. Just flip them forward (which you'll be doing a lot if you use the print mode menu) and then, when you're done, flip the cov-

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Fujitsu DL3400
Fujitsu America Inc.
3055 Orchard Dr.
San Jose, CA 95134-2017
(408) 432-1300
List Price: With parallel interface, $995; serial interface, $30; color option kit, $100.
Dimensions (HWD): 5.5 × 24 × 15 in.
Weight: 27 lbs.
In Short: This speedy (143-cps) 24-pin wide-carriage dot matrix printer has built-in fonts and lots of features, but the flexible print mode menu can be somewhat irksome to use.

CIRCLE 678 ON READER SERVICE CARD

ers back. They fall right into place. In addition, the tractor/pin-feed unit works well in both directions. And inserting the optional font cards is designed to be easy; you simply push them through a slot on the cover of the machine.

Like most forward-thinking printer manufacturers, Fujitsu left out DIP switches on this machine. Unless you like to program, you can set all your choices through the SETUP mode and then select them from the front panel.

The printer comes with a parallel port; a serial port is $30 more. The four-color printing option costs $100 and adds Epson JX-80 color printing compatibility. The color option works as promised, in both high- and low-resolution color modes.

> Few observers would believe that the print from the Fujitsu DL3400 came from a laser printer, but they might have to look carefully to determine that it didn't.

DOUBLE FEATURES After you figure out how to use the somewhat confusing front panel, you can double it up with the extensive features menu to switch quickly among various combinations of print modes and settings. The switches include buttons for on/off-line, form-feed, line-feed, and mode. With the printer off-line, you can hit the mode button to activate one of three additional sets of choices, selected by hitting the normal form-feed or line-feed buttons. LED indicators show which group of choices (or mode) is available. You can set letter or draft quality, one of two predefined fonts, or one of two full printer setting configurations called Menu1 and Menu2.

USING SETUP To take full advantage of the control panel and to change any settings on the DL3400, you have to master the SETUP mode. To enter SETUP, you press the mode button while turning on the printer. All mode indicators then turn on, and the printer prints the top-level menu. This menu lets you choose among defining the panel, settings for Menu1 or Menu2, hardware selections, list (which prints a listing of all current settings), and default, which puts everything back to the original factory settings in case you want to start all over again. You can also select self-testing, hexadecimal mode, vertical alignment, top-of-form, and saving and/or ending the SETUP session.

You know where you are in the menu system by a small red indicator on the printer card guide, a clear plastic piece in front of the printhead. The printhead mechanism moves around to put the red mark directly under the current choice. Whenever you are working within a menu, the previous setting is partially underlined. When you make a new choice, the new choice is fully underlined. One design glitch I find annoying is that you have to fold the printer top and front covers forward to see the menu.

The most powerful way to use the SETUP mode is to customize two configurations besides defining your preferred default mode. These configurations can include everything from printer emulation, print quality, font, pitch, line spacing, page length and width, and top margins to deciding between slashed or nonslashed zeros, and other type enhancements. One combination would be to have the default panel set to high-speed-draft print in 10 pitch, Menu1 set for your preferred letter-quality font and settings, and Menu2 set for wide spreadsheet reports in condensed mode.

With all this flexibility, being able to print out a listing of the current settings is not only convenient, it's necessary. The printout is important both as an ongoing reference and as a quick way to see what you've wrought while trying to configure the printer.

In general, the documentation for the Fujitsu DL3400 is fine, but we found a significant error in the worst place: the section on using the SETUP mode. The manual says that you move between menu selections by tapping the on-line button when actually you must use the mode button to do so. Until Fujitsu corrects that error (and they say they will), users who are disinclined to experiment will be stymied when they try to take advantage of the powerful SETUP mode.

The Fujitsu DL3400 requires investment in learning time, but once mastered, it's a flexible, speedy machine that prints well. If you have an extra $500 to spend, you may want to hold out for the faster, more rugged Fujitsu DL2600, which uses an LCD screen for menu selections. But if your budget is tight, try the Fujitsu DL3400, a good middle-price-range printer laden with features.—**Bruce Brown**

Fujitsu DX2300 and DX2400

The Fujitsu DX2300 and DX2400, 9-pin $645 narrow-carriage and $845 wide-carriage printers, are testimony to the fact that when you care enough to design the very best, it shows. Since most dot matrix printers designed for today's PC market are IBM graphics compatible, reasonably speedy, and capable of producing acceptable draft and near-letter-quality print, manufacturers are most likely discovering that making a truly outstanding competitor is pretty tough.

But not Fujitsu. It has given the Fujitsu DX2300 and DX2400 some design features that not only indicate the company's care, but also make the printers stand out from the crowd. Additionally they make the printers more convenient to use, probably extending their functional lifespans as well.

For their price range, both the Fujitsu DX2300 and DX2400 achieve competitive speeds. The DX2300 prints 129 characters per second in draft mode and 38 cps in acceptable NLQ mode. The 132-column DX2400 is slightly faster, at 132 cps draft and 42 cps NLQ; it improves by about 20 percent when printing wide text, achieving 157 cps in draft mode. This faster print rate on wide paper makes a real difference when you are printing accounting reports, spreadsheets, mailing labels placed three or four across, and other wide-carriage print jobs.

The print quality of both the DX2300 and DX2400 won't fool anyone—it's definitely from a dot matrix. Normal draft

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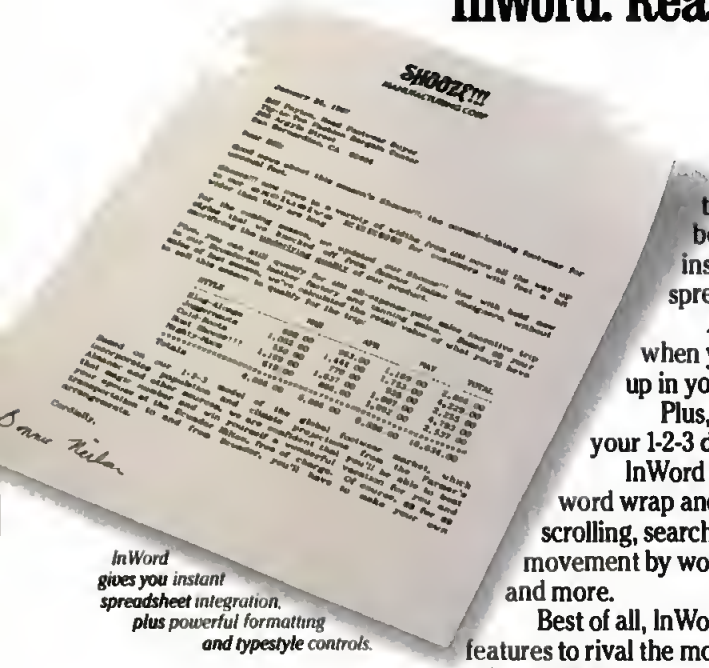
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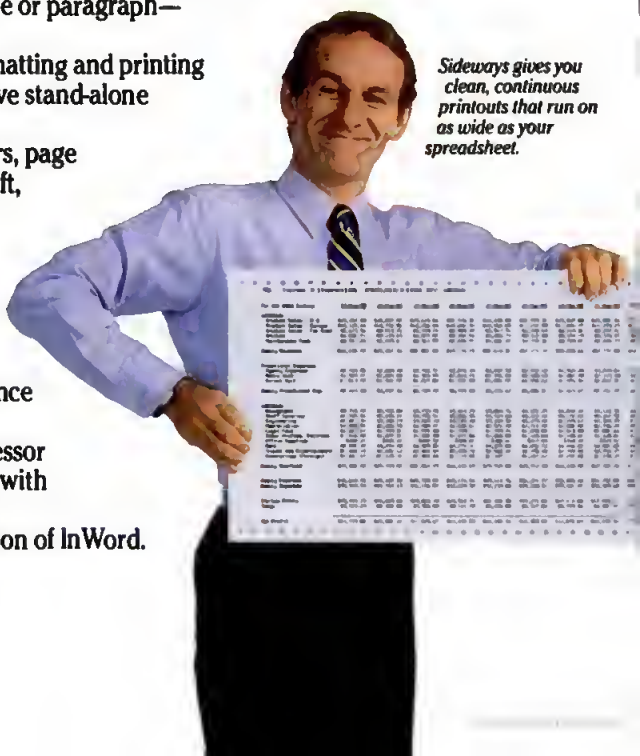
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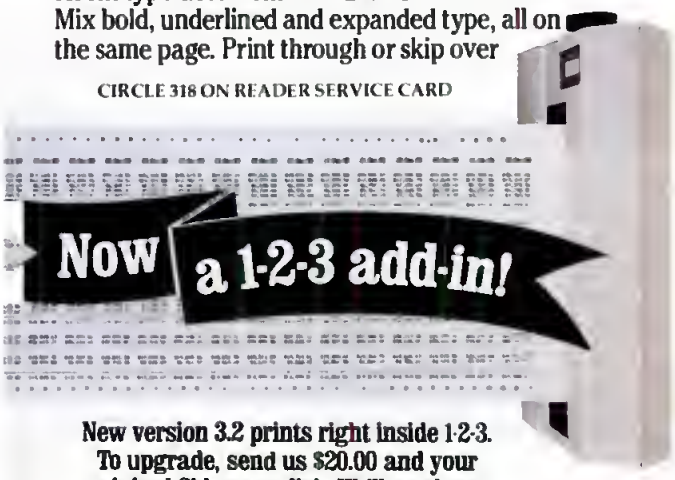
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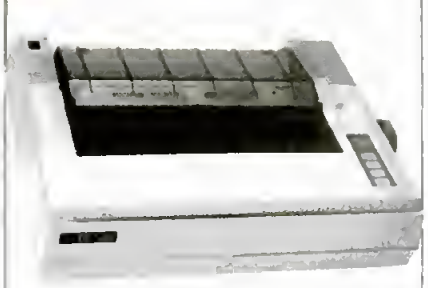
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Fujitsu DX2300 and DX2400
Fujitsu America Inc.
3055 Orchard Dr.
San Jose, CA 95134-2017
(800) 626-4686
(408) 432-1300
List Price: DX2300: with parallel interface, $645; with serial interface, $695; color option, $100. DX2400: with parallel interface, $845; with serial interface, $895; color option, $100.
Dimensions (HWD): DX2300: 5.5 × 18.25 × 14.5 in.; DX2400: 6 × 23.5 × 16 in.
Weight: DX2300: 20.2 lbs.; DX2400: 25.7 lbs.
In Short: The 9-pin Fujitsu DX2300 and DX2400, the narrow- and the wide-carriage versions of the same printer, are sufficiently fast (129 and 157 cps, in draft, respectively), produce acceptable dot matrix NLQ print, and are distinguished by good design.
CIRCLE 676 ON READER SERVICE CARD

print meets most internal reporting needs and is good enough for normal mailing labels. The NLQ print is reminiscent of the print produced by printers like the Okidata 82A back in 1982. That quality, called "correspondence quality," was impressive then, but like the NLQ print of the DX2300 and DX2400, it cannot, of course, measure up well against the "letter quality" print that most modern 24-pin dot matrix printers produce.

The Fujitsu DX2300 and DX2400 can produce 10, 12, 15, 17.1, and 20 characters per inch in both NLQ and draft modes. Front-panel switches control on/off-line, form-feeds, and line-feeds, and let you select NLQ mode. By using a combination of DIP switches and one slide switch, you can change fairly quickly between IBM and Epson FX-80 modes. In IBM mode you can choose between IBM Graphics Printer and Proprinter emulations. Additional fonts are not available for either printer.

Overall, both these 9-pin printers produce the expected quality type at the expected speeds and are compatible with industry standards. They're also reasonably quiet, both scoring under 70 decibels in all modes.

EASY-TO-USE COVERS So what else is new? The news is that some of the design features of these printers make so much sense that you wonder why all printers don't incorporate them. The soundproof cover, front cover, and top cover of the DX2300 and the DX2400, for example, all hinge together in one folding unit. The unit hangs down in front of the printer until you're ready to close it again. Then you can fold it easily back in place. If you're tired of having to take off a printer's top cover, put it down somewhere, then remove the front cover and put it somewhere else before changing a ribbon cartridge, or adjusting or loading paper—then putting all the pieces back together again when you're finished—you'll appreciate Fujitsu's foolproof design.

Also, the rear cover is cleverly designed to act as a paper-feed guide for single sheets and an exit path for continuous forms. Easy-to-adjust variable-width guides help keep the paper straight.

Another nifty feature is the way you remove the printer memory and DIP switch card and insert it into the printer. This card is conveniently located under a sliding panel on the top-right rear of the printer. If you need to make an adjustment, say, to change from Epson to IBM emulation, you merely loosen one screw on the back of the machine (the screw has a convenient dime-sized turn slot). Next you push the cover to the rear. The vertically mounted circuit card has two plastic butterfly-shaped pieces that fold upward and become handles for pulling the card out. After you change DIP switches, you insert the card in edge guides, which ensure accurate placement, and then push down gently on the plastic pieces.

This feature works well and takes the apprehension out of removing a circuit board from the printer. The first time you remove the card, reset the switches, and reinsert the card takes about 3 or 4 minutes. Subsequent changes take less than 15 seconds.

> The Fujitsu DX2300 and DX2400 can produce 10, 12, 15, 17.1, and 20 characters per inch in both NLQ and draft modes.

Installing the clamshell-style cartridge ribbon is a breeze. All you do is place the ribbon in its carriage with the two side-mounted protrusions in place and exert a minimum of downward pressure. Loading paper is also fast and easy. Pressing the form-feed button automatically advances paper you insert. The internal tractor works fine in both directions.

The Fujitsu manual is certainly adequate, but no award winner. Its handy Quick Start Chart refers to other applicable sections of the manual, but the manual gives information on running the printer self-test before it instructs you on how to install the ribbon and paper (which appear in a different chapter). The lack of an index compounds the problem. Also, although several appendixes give all the information experienced users need to configure or program the printer, the manual devotes too little space to programming for beginners.

The printers are available with either parallel or serial interfaces, but not both. The serial models cost $50 more than the parallel ones. Another option is a four-color printing kit for $100. With the color options installed, the printers are compatible with the Epson JX-80.

The Fujitsu DX2300 and DX2400, priced well for their performance level, enjoy the distinction of being better designed than most in their class. Their commendable design features will not only make these printers more convenient to use and most likely lengthen their lifespans, they will earn them your long-lasting gratitude.—**Bruce Brown**

Genicom Centronics Printstation 220

The Genicom Centronics Printstation 220 is a fine $599 9-pin wide-carriage dot matrix printer—once you manage to set it up.

Like many other printers, the Centronics Printstation 220 houses its DIP switches under a panel inconveniently located beneath the belt drive and ribbon. You can use the DIP switches to change from parallel to serial port and to print a slashed zero, as well as to change the default of the printer from normal to emphasized print and to change compatibility modes from Epson to IBM. According to the manual, it's necessary to remove the ribbon before resetting the DIP switches, but I found it was not difficult to reach the switches without having to do so.

That's good, because the ribbon-guide holder, which is supposed to help you place the ribbon around the printhead, makes it impossible to install the ribbon without getting a considerable amount of ink on your fingers.

The cover is also difficult to remove and replace. The cut-sheet guide is ingeniously designed to double as a paper guide; however, it is advisable to use it in its up position when you are using forms. When the cut-sheet guide was in its down position, forms tended to reload themselves through the back of the printer.

The Centronics Printstation 220 comes with a separate pin-feed mechanism that is difficult to install. To attach the pin-feed to the printer, you press two pressure-sensitive buttons, neither of which proved to be terribly sensitive. Once the pin-feed mechanism is in place, though, there's little reason to remove it. But a small tweezerlike instrument useful for removing the pin-feed is included with the printer just in case.

The design of the Centronics Prinstation 220 isn't all bad. The printer's on/off switch has been conveniently located on the front of the machine and its touch-sensitive switches on the top. These include power and check LEDs, an on-line button and LED, line-feed and top-of-form buttons, an NLQ button and LED, and a button that controls the automatic load from either a sheet-feeder, forms, or single sheet. The parallel port (or the serial port, if you want to use it) and power cable are located on the back of the printer.

Once you set up the Centronics Printstation 220, you'll find that loading paper is a snap. After you secure the paper in the pin-feeds, the load-forms button automatically slides the paper around the platen and under the paper guide. The printer is designed so that the cut edge is just between the window cover and the cut-sheet guide, making it very easy to tear the paper.

I found the near-letter-quality print to be good, especially for a 9-pin printer. The curves of the letters are a bit jagged, but quite readable and suitable for most business documents. The quality of the draft output is perhaps more uneven than average and thus more difficult to read.

If you're not happy with the printer's default Prestige type, you can buy optional NLQ font cartridges. The LQ-100 font cartridge, priced at $105, contains Gothic, Quadro, and Anelia Proportional type; the LQ-200 font cartridge, priced at $120, holds Gothic and Anelia Proportional and also includes a 16K-byte input/download buffer.

At 72 decibels in draft mode, the Centronics Printstation 220's sound level is not too hard on the ears. It is, unfortunately, quite a slow printer. We clocked it at 99 cps in draft mode in wide carriage and at 28 cps in NLQ mode.

The Centronics Printstation 220 is, on the whole, a decent 9-pin printer. The presence of a separate pin-feed mechanism and a switch-operated automatic-load function suggests that the vendor tried to alleviate problems it saw in its competitors' products. If Genicom can add to those innovations a somewhat higher print quality and faster speed, it will have a real contender on its hands.—**Barbara Krasnoff**

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Genicom Centronics Printstation 220
Genicom Corp.
One Genicom Dr.
Waynesboro, VA 22980
(800) 4-GENICOM
(703) 949-1170 (in Va.)
List Price: $599
Dimensions (HWD): 3.1 × 19.3 × 12.0 in.
Weight: 15.2 lbs.
In Short: A 9-pin wide-carriage dot matrix printer that offers a fine array of paper feeds and typefaces, but at 99 cps is slow in draft mode and even slower at 28 cps in NLQ.

CIRCLE **665** ON READER SERVICE CARD

Hewlett-Packard PaintJet

With Christmas just around the corner, you're in luck. Find the nearest Santa, sit down on his lap, tug on his beard to verify his authenticity, and then ask him for Hewlett-Packard's latest gem—the HP PaintJet color graphics printer.

Boasting 330 predefined colors and three near-letter-quality fonts, the $1,395 narrow-carriage HP PaintJet may break ground as the only color graphics printer versatile enough, fast enough, and cheap enough to find its way onto many a businessperson's desk.

The HP PaintJet uses ink jet technology to achieve its wonders, but Hewlett-Packard has apparently eliminated at least one drawback of some ink jet printers: clogging spray nozzles and messy ink cartridges that seem to leave more ink on your hands than on the paper.

Instead of using one permanent spraying mechanism that draws its ink from separate cartridges, the HP PaintJet uses two ink cartridges—one black and one three-color—with built-in spray nozzles. This approach helps reduce nozzle clogs, since you replace the nozzles each time you replace the cartridges.

A handy pump mechanism built into the printer lets you prime the ink cartridges in a no-mess flash, and a built-in cartridge wiper removes debris from the cartridge print nozzles, further helping to reduce clogs.

I removed and reinstalled the ink car-

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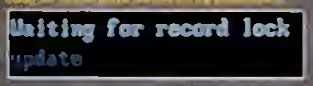
And only Smart lets you create custom programs that actually jump between applications. So, for instance, a single keystroke can transform a worksheet into a 3-D pie chart, paste the chart into a document, and send the document via modem to the home office.



Smart's "REMEMBER" command lets non-programmers create custom programs.



Smart's "SEND" command makes it easy to move data between applications.



Smart automatically protects your data in multiuser environments.

Between Workstations

Every Smart application includes a fully automatic File or Record-Locking scheme for shared data. So right out of the box, Smart can be used either on a single user PC or on a LAN workstation.

Between DOS and UNIX

There are even versions of Smart for multiuser UNIX® and XENIX® systems; all 100% file compatible with the DOS version of Smart.

Which, according to Information Week, makes Smart "the first to provide DOS-UNIX-LAN connectivity without sacrificing power and features."

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PC MAGAZINE FACT FILE



Hewlett-Packard PaintJet
Hewlett-Packard Co.
1820 Embarcadero Rd.
Palo Alto, CA 94303
(800) 752-0900
List Price: $1,395
Dimensions (HWD): 4.5 × 18 × 12 in.
Weight: 11 lbs.
In Short: A reasonably priced 78-cps narrow-carriage ink jet color graphics printer that feels at home printing NLQ text or 16-color bar charts.

CIRCLE 633 ON READER SERVICE CARD

tridges several times without so much as seeing a drop of ink, much less getting one on my hands or desk.

However, you're still chained to costly, special-coated paper if you want high-quality output. Paper for the HP PaintJet sells for $17.95 per 250-page, Z-fold package, or 7¢ per sheet. The price drops to $15.95 per package if you buy by the case.

The HP PaintJet prints text at 180 dots per inch and color graphics at either 90 dpi or 180 dpi, depending on your color requirements.

At 180 dpi, you have a choice of six colors, plus black, for text and graphics: the printer overlays combinations of its three ink colors—magenta, yellow, and cyan—on each dot to give you the red, green, and blue.

330 COLORS To give you 330 colors, the printer groups dots into two-dot by two-dot "super pixels" for an effective resolution of 90 dpi. Each of the four dots can be colored black, white (no printing at all), or one of the six primary colors. The idea is that each combination of four dot colors will appear to the human eye to be a large pixel of one solid color.

The HP PaintJet offers a high-density mode for printing transparencies—a nice touch for anyone who gives presentations on a regular basis. But you'll have to stick to the six primary colors and a few others to get presentation-quality results, even when using Hewlett-Packard's special-coated transparency film.

Hewlett-Packard has made it easy to access any of the 330 colors by indexing them to the standard RGB values, but you can print from a palette of only 16 colors at a time, by far my greatest complaint with this printer. You can move any color into the palette at any time using a string of four escape sequences, but this still limits you to 16 colors for all practical purposes.

The HP PaintJet prints about the same quality NLQ text you'd get from a low-end dot matrix printer and prints in three fonts: 10-pitch Courier, 12-pitch Letter Gothic, and 18-pitch Letter Gothic. But you probably wouldn't buy this printer for text-only jobs, of course.

Our speed tests didn't bear out the PaintJet's 167-cps rating, but at a tested speed of 78 cps the PaintJet is still fairly fast. A full page of color graphics requires about 4 minutes to print.

All in all, the PaintJet gets high marks for its intelligent design: it presents itself as the printer that might finally make transferring dazzling color screen images into hard copy affordable and practical. Just how powerful this printer will be in practice, though, depends on how fully applications programs will exploit its potential.

According to Hewlett-Packard, 53 packages will support the PaintJet by midfall, including *Freelance Plus*, *Harvard Graphics*, *1-2-3*, and *Microsoft Chart*. While some packages, such as *Boeing Graph*, give you a fairly wide selection of colors to play with, most support only 8 to 15 of the printer's 330 colors.

Eight colors should satisfy the needs of most business users, but users with more ambitious color printing in mind will have to wait for the makers of paint programs to figure out how best to tap the PaintJet's potential. As of this writing, Hewlett-Packard listed no paint programs among the packages supporting the PaintJet.

On a high note, Hewlett-Packard is bundling a handy printscreen utility with the printer that lets you dump color screens from just about any program to the PaintJet. I had no problem dumping color graphics from *1-2-3*, *R:base Graphics*, and—yes, I'll admit it—*PacMan*.
—Mitt Jones

Honeywell Bull 4/66

If looking the part is half the battle, then Honeywell's Bull 4/66, a $2,400 18-pin dot matrix printer, is certainly dressed for success. Its massive size, understated beige color, and high-tech front panel all suggest quiet competence. This is a printer intended for heavy business use where speed, versatility, and ruggedness are prerequisites.

The Honeywell Bull 4/66 is fast. In our speed tests, it raced through the sample two-page letter at 235 characters per second in draft mode on 14-inch-wide paper. In near-letter-quality mode, I clocked it at 63 cps—more than some low-end dot matrix printers can manage in draft.

One anomaly surfaced when I tested the Honeywell Bull 4/66 for speed. It ran at

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Honeywell Bull 4/66
Honeywell Bull Italia
120 Howard St., #800
San Francisco, CA 94105
(415) 974-4340
List Price: $2,400
Dimensions (HWD): 6 × 25 × 16.25 in.
Weight: 50 lbs.
In Short: A 235-cps 18-pin wide-carriage office machine that offers good quality print, excellent paper handling, and a variety of features.

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235 cps with draft mode selected by default at power-up, but managed only 205 cps when draft print was selected through software. The printer reconfigures itself each time it receives a print mode command. Our benchmark tests issue a command at the beginning of each line of text, so the printer got slightly bogged down in software overhead before printing each line. But this is not a real-world problem, since hardly any software program issues commands before each line.

The Honeywell Bull 4/66 has almost all the features that a top-of-the-line dot matrix printer should have, including the usual text enhancement abilities. It doesn't support proportional spacing, however, which is a curious omission considering all the other things it does.

Print quality is quite good. In NLQ mode, the resident Courier typeface is smooth and dark, though not quite up to a laser or daisy wheel printers. Additional typefaces are available in font cartridges for $50 each. Bold type is very dark and clean looking; it really stands out on the page. The Honeywell Bull 4/66 also provides decent-looking italic, compressed, superscript, and subscript print.

The Honeywell Bull 4/66 handles paper efficiently and smoothly. The built-in tractors are easy to load and adjust. An outstanding feature is the single-sheet slot located under the front control panel. It has adjustable paper guides and handles wide-format paper. But the best thing about it is its automatic paper-parking routine. When you insert a cut sheet into the slot, the Honeywell Bull 4/66 automatically backs fanfold paper out of the paper path. After the cut sheet is printed, a flick of the paper load lever moves the continuous forms back into ready position.

The Honeywell Bull 4/66's very high-tech front panel has an array of eight touch-sensitive switches, three LED indicators, and a small LED readout. Aside from the usual switches for on-line, form-feed, and line-feed, the control panel has five switches that access a menu of virtually all the printer's important functions. The Honeywell Bull 4/66 has no user-accessible DIP switches.

Tapping a switch marked "prog" gets you into the menu, and you proceed through different submenus to select the feature you want. The menu system is a bit confusing at first and definitely takes a little getting used to. A larger and more informative LED readout would be helpful.

The design of the Honeywell Bull 4/66 suggests that it is meant to handle large-volume printing jobs, and its size and weight reinforce that impression. At 6 by 25 by 16.25 inches (HWD), it takes up quite a bit of desktop real estate. And its 50-pound weight places it far from the portable category.

It's not cheap, and it's not small. But the Honeywell Bull 4/66 is not intended for individual users or portability. It's an office machine, and the office is where it is likely to show off its considerable capabilities.—**Jonathan Matzkin**

IBM Proprinter II

It wasn't too many years ago that IBM created a printer standard: a sturdy, high-quality 9-pin dot matrix printer called the Proprinter, which was an Editor's Choice in our 1985 printer roundup. In 1986 came the $799 Proprinter XL, a wide-carriage, enhanced version of the old faithful. This year IBM has introduced the Proprinter II, a narrow-carriage machine that bears the same $549 list price as the original Proprinter.

PC MAGAZINE FACT FILE



IBM Proprinter II
IBM Corp.
101 Paragon Dr.
Montvale, NJ 07645
(800) 447-4700
List Price: $549
Dimensions (HWD): 5.25 × 16.5 × 13.8 in.
Weight: 18.1 lbs.
In Short: Although it's not strong on design, the 129-cps (draft) Proprinter II is an excellent basic 9-pin narrow-carriage dot matrix printer for business applications.

CIRCLE 453 ON READER SERVICE CARD

The programmable Proprinter II is a squat box of a printer with a familiar feel to it. Like the Proprinter XL, it has a large slot in the front for separate sheet paper feeding. You can use cut forms while continuous forms are still in the printer by draping the cut forms over the continuous. It's a bit awkward, but acceptable. The continuous forms keep rolling while printing, so expect to waste some paper.

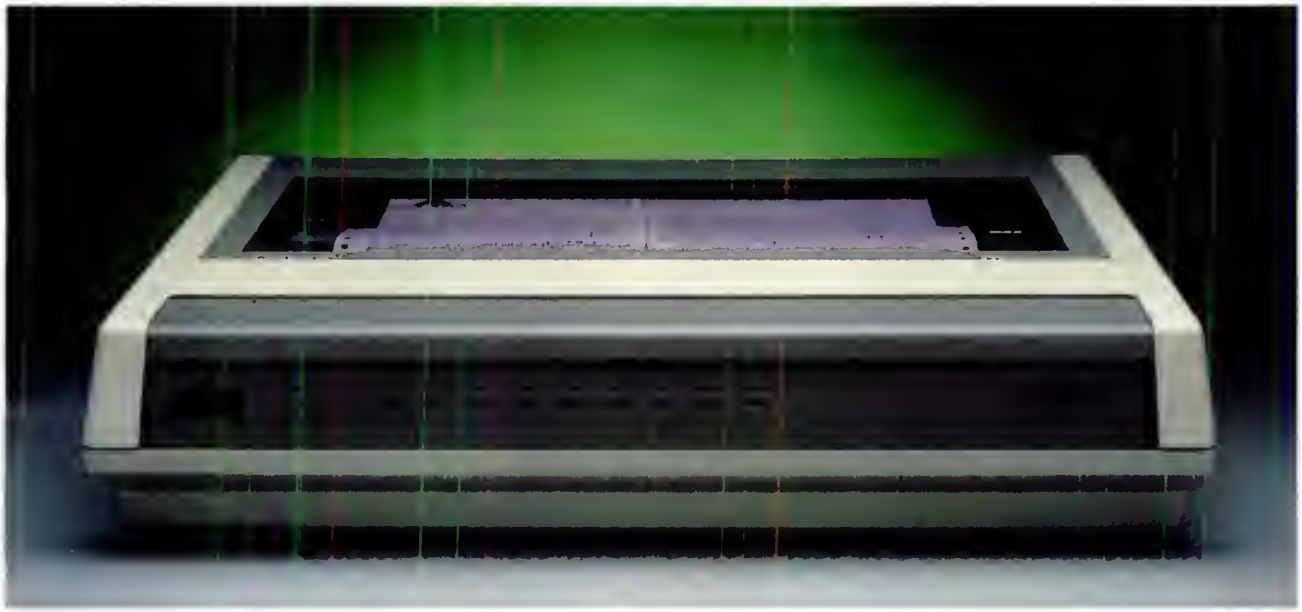
A square function panel includes the power switch, NLQ/paper-out and ready lights on the top line, and the LF/quiet mode, FF/load-NLQ/DP, and on-line switches on the bottom. Unlike most other printers, the Proprinter II changes from NLQ to DP (draft) when the ready light is on; when it is off, the same switch is used to load or feed the paper. The LF switch is also used to activate the printer's quiet mode, which reduces the noise from 74 decibels to 69 decibels during draft printing, but doesn't have any effect during NLQ printing.

The Proprinter II is slower than another new addition to the IBM line—the $799 24-pin narrow-carriage Proprinter X24. We clocked the Proprinter II at 129 characters per second in draft mode and 32 cps in near-letter-quality. These speeds fall short of those of the Proprinter X24: 172 cps in draft and 68 cps in NLQ.

Unlike most other dot matrix printers, the Proprinter II's pin-feed accepts form-feed paper under rather than over the platen. As a result, loading forms can be somewhat difficult. Rather than fitting the pin-feeds to the paper, you must approximate where the proper position of the paper is, press the form-feed button, and hold the paper where you hope the pins will catch the holes.

The DIP switches are located under a panel on the left side of the printer, near the back. According to the manual, you must remove fanfold paper to gain access to them, but I was able to take off the cover and reach the DIP switches without having to do so. The DIP switches govern functions such as line-feed and character set;

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most printer features can be programmed using the front-panel controls.

The Proprinter II uses a variety of tones to signal such conditions as errors or new modes. More than a euphonic innovation, the tones play an important part in the programming of the machine. Using the printer's front panel, you activate the Proprinter II's programming mode by pressing the line-feed and on-line buttons simultaneously. After three tones announce that the printer is ready, you press the line-feed button to scroll through nine modes: Fastfont, 12 pitch (elite), condensed print, proportional print, emphasized print, double-high print, double-wide print, slashed zero, and printer reset. Each time you reach a new mode, a tone sounds. Two tones let you know that you've reached the end of the list. When you reach the mode you want, you can program it by depressing the form-feed button.

Clocked at 172 cps in draft mode and 68 cps in near-letter-quality, the narrow-carriage X24 closely resembles IBM's other Proprinters in its square dimensions and interesting methods of accommodating both fanfold and cut-sheet paper.

The Proprinter II also has a fine selection of typefaces. It has both serif and sans serif NLQ modes, which can be chosen either by control codes or by resetting the DIP switch. The Fastfont mode is a good choice when you're in a hurry but not selective about type quality: it saves time by eliminating most of the spacing between letters.

The NLQ print quality is excellent. The lettering in both serif and sans serif modes is well defined and even, with none of the heaviness and jaggedness that typifies the output of most 9-pin printers. The draft quality is a little too light and disconnected to make for comfortable reading, but it's adequate for first drafts. The Proprinter II does not support italic type; however, it did produce clean, crisp graphics.

The Proprinter II is definitely not distinguished by its design. But if you believe that beauty is in the quality of the output, then IBM's latest entry could be for you.

—Barbara Krasnoff

IBM Proprinter X24

Business users who want both the flexibility of a dot matrix printer and the handsome output of a laser printer can usually turn to a 24-pin printer for quality type. IBM, whose Proprinter line has proved an excellent choice for dot matrix enthusiasts, has its own 24-pin entry called, appropriately enough, the Proprinter X24.

Clocked at 172 characters per second in draft mode and 68 cps in near-letter-quality, the $799 narrow-carriage X24 closely resembles IBM's other Proprinters in its square dimensions and interesting methods of accommodating both fanfold and cut-sheet paper. But the Proprinter X24 is significantly faster than IBM's other recent entry, the Proprinter II, which we clocked at 129 cps. Both of these models are faster than last year's Proprinter XL, which we timed at 120 cps.

The Proprinter X24 stands a bit higher than many printers of its type, but also has a slightly smaller footprint. There are two removable covers: one hides the printhead and ribbon, and the other acts as a very effective paper guide. The DIP switches, which control such functions as line length, form length, and automatic carriage return, are located under a panel at the left side of the printer; thus the only reason you'd have to open the printer would be to replace the ribbon. A wide-carriage version, the $1,049 Proprinter XL24, is also available.

Like other IBM machines, the Proprinter X24 feeds fanfold paper through and down the back of the platen; you load the printer by trying to catch the holes of the paper in the rolling pin-feed. It's reminiscent of what might be a child's mechanical toy, and it usually took me two or three tries. You can feed individual sheets through a slot in the front; if the printer is already loaded with fanfold paper, you simply load one over the other. This process usually works quite well, but be aware that if you have more than one page in your document and you are feeding in cut sheets with fanfold in place, the printer won't automatically stop for the second sheet; it will continue to print it on the fanfold paper. The paper, once loaded, feeds in well, and the paper separator does a good job of preventing refeed.

Multipurpose switches are also characteristic of IBM's Proprinter series. On the X24, the switch panel is located to the left of the cut-sheet-feeder and has several rows of LEDs and rectangular buttons. The top row has lights for power, quiet mode, and ready. The quiet mode, which you can choose when the printer is on-line, reduces the noise level from 74 decibels in draft to 72 decibels but also slows the printer down a bit.

The second row labels three switches for their on-line and off-line capabilities. The leftmost button toggles the printer to and from letter quality when the printer is on-line and enables you to select one of

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IBM Proprinter X24
IBM Corp.
101 Paragon Dr.
Montvale, NJ 07645
(800) 447-4700
List Price: $799
Dimensions (HWD): 5.25 × 16 × 14.3 in.
Weight: 17.2 lbs.
In Short: A well-built, capable 172 cps 24-pin narrow-carriage dot matrix printer with some programming capabilities and good type quality.

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four pitches when you are off-line: 10, 12, 17, or proportional.

Three LEDs below the switches are labeled 12, 17, or propor.; if none of them is on, the printer operates in 10 pitch. The middle switch activates either the quiet mode or, when off-line, feeds the paper either line by line or to the top of the page; the rightmost switch puts the printer on-line or off-line.

You can also use these switches to program the Proprinter X24. You place the X24 into programming mode by pressing the Ltr Q/Pitch and On-line buttons simultaneously when the printer is on-line. The printer responds with a series of three tones and a flashing ready light.

You then scroll through five choices by hitting the Ltr Q/Pitch key. The settings are listed in the manual and on a small label pasted on the printer cover. They include emphasized, double-high, double-wide, slashed zero, and printer reset. If you need additional letter quality fonts, you can obtain them from IBM's FontSet, a $109 kit that includes a memory chip and a disk containing several downloadable type styles.

Once a type style has been loaded into the printer's memory, it will remain in effect until a new one is loaded. The printer will default to that setting when it is turned on, or it will default to 10-pitch DP (draft) if no type style has been loaded.

You choose the feature you want by pressing the Quiet/Feed key; the on-line switch will take the printer out of programming mode. You can also reprogram the printer while you're printing a document. The printer will simply stop to accept instructions, then resume printing in the new type.

The print quality of the Proprinter X24 in NLQ 10-pitch, sans serif DP, and 12-pitch elite is clear and clean; of the standard-sized typefaces, the printer also offers 12-point DP and Courier in both 10 point and proportional. The draft DP output is a bit light but quite readable. Two years ago this quality of type output would have been outstanding for $799; now you can find better for this price.

Altogether, the Proprinter X24 is a typical IBM printer: sturdy, well planned, and capable of providing good standard service.—**Barbara Krasnoff**

IBM Quietwriter III

The $1,699 wide-carriage IBM Quietwriter III is for people with supersensitive ears (those who think laser printers are too noisy) and people with supersensitive eyes (those who think the output from a laser looks more like a copy than like an original).

Unlike a laser printer, whose fan noise can be a faint but constant annoyance in the background to some, the thermal transfer Quietwriter III makes noise only when it's actually printing. Then the Quietwriter III, true to its name, whispers along so quietly that you'll hardly know it's there. When we measured its 58-decibel sound level, the sound of rustling paper was significantly louder than the sound of the printer in operation.

If you object to laser printer output because it looks like it was produced by a photocopy machine, then you will probably prefer the Selectric quality of the Quietwriter III. Its letter quality print looks like daisy wheel output, with none of the smudges that you can get from an out-of-tune laser printer, and with no hint of the dots that can betray a dot matrix printer. Even the draft quality output looks like that of a fully formed character printer, except that the characters appear a little fainter (as if printed by a worn-out fabric ribbon).

The up-to-date thermal transfer technology of the Quietwriter III is responsible for its good-looking output. Unlike the printheads on most dot matrix printers, the printhead on the Quietwriter III has a matrix of 41 electrodes. The electrodes heat up and melt the thermal transfer ribbon's ink into the paper. The output looks every bit as good as anything you'll see from a laser printer. You may even think it looks better. Other printers that use thermal transfer technology include the Apple Scribe and the portable Ergo Systems Hush 80.

The Quietwriter III is in letter quality mode when you first turn it on, but you can make it default to any of the modes by setting the appropriate DIP switches. You can also switch among modes by using the front panel or by sending escape codes via software.

FINE GRAPHICS QUALITY The printer's 240-dot-per-inch graphics output is unusually dark and crisp, thanks to the machine's 41-electrode printhead. In the PC Labs benchmark tests the printer proved its claims of IBM Proprinter graphics emulation. Moreover, the Quietwriter III's speed and low noise level for graphics are just as impressive as its graphics print quality. To adjust the print quality in response to changes in the paper, ribbon, and climate, you can use the printer's three-position contrast control.

The machine itself looks as good as its output. Like most of IBM's printers, the Quietwriter III has a solid look and feel that suggests rugged reliability. Yet the printer is surprisingly lightweight (only 24 pounds) because of the thermal-transfer technology—certainly not from a lack of toughness.

The six front-panel buttons and seven control lights add some color to the machine. In place of a paper control knob, the Quietwriter III has two front-panel buttons that you use to move paper up and down; hence you can't adjust the paper easily un-

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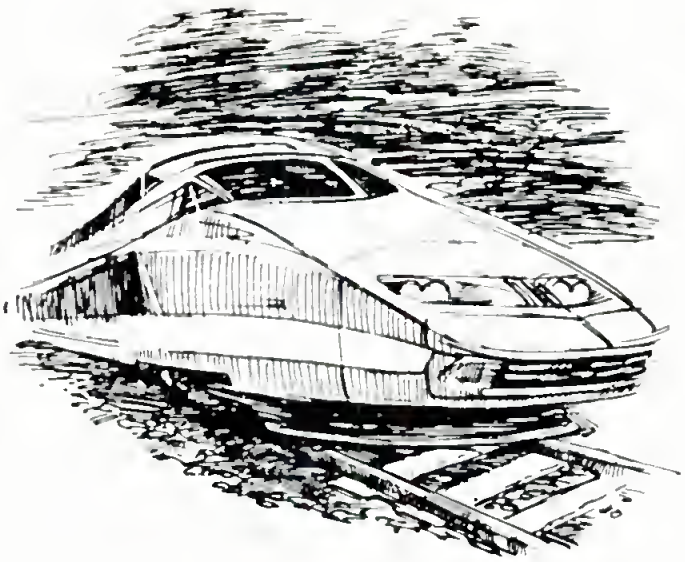


IBM Quietwriter III
IBM Corp.
101 Paragon Dr.
Montvale, NJ 07645
(800) 447-4700
List Price: $1,699
Dimensions (HWD): 7.1 × 21.7 × 15 in.
Weight: 24 lbs.
In Short: This 81-cps wide-carriage thermal-transfer printer is in the same price range as a low-end laser printer, but high-quality text and graphics, IBM Proprinter compatibility, and low noise make it attractive nonetheless.

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PC MAGAZINE EDITOR'S CHOICE

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PC WEEK

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less the printer is on. Other front-panel buttons include form-feed, set top-of-form, mode, and start/stop. The form-feed button doubles as a reset button to clear the printer's memory and reset it to the power-on default settings. The LEDs on the front panel tell you which mode the printer is using at the time.

SATISFACTORY SPEED The Quietwriter III's print speed is acceptable but not one of its strong points. On the PC Labs tests the printer scored 81 characters per second in draft mode and 64 cps in letter quality mode using 10 pitch on a wide-carriage printout. On the narrow-width printout it managed only 71 cps in draft mode. Still, those speeds are significantly faster than that of last year's Quietwriter Model 2, which we clocked at 28 cps in narrow carriage.

Built-in fonts for the Quietwriter III, although adequate for most purposes, are limited to a Courier font in 10, 12, and 17 pitch and a proportional space font, which is a modified Courier font. Additional fonts are available on plug-in cartridges. Downloadable fonts are also available, but you must transfer them from disk to cartridge. The cartridges, called download cartridges, are blank when purchased and must be programmed from the fonts on disk.

The Quietwriter III offers automatic paper feed for single sheets—a convenient feature to have on hand. Paper-feeding options include a bidirectional pin-feed, a one-bin or two-bin sheet feeder, and an envelope feeder.

Moreover, the user manual is up to IBM's usual high standards of quality: it is both well written and well illustrated, informing you of most of what you need to know to operate the printer.

The only drawback to the Quietwriter III is its price. With some laser printers now selling for under $2,000, $1,699 seems high for a printer whose speed is measured in characters per second rather than pages per minute. Still, the IBM Quietwriter III produces both high-quality text and graphics quietly, and unlike most laser printers, it is able to handle envelopes and labels easily. That combination is more than a little appealing.—**M. David Stone**

EZQueue 3000 . . . Peripheral Sharing Plus!

Giltronix EZQueue™ allows from six to twenty-four computers to simultaneously share one or more laser printers, dot matrix printers, or plotters. In just a few minutes, you can configure EZQueue to efficiently manage a single shared printer or multiple printers depending on your need. Ten simple to use and expandable models are offered, each with up to two megabytes of dynamic buffering.



Increased Productivity
EZQueue goes beyond the cost advantages of sharing expensive printer resources. Files containing data for printing mailing labels can be directed through EZQueue to a dot matrix printer. At the same time, letter quality files can be directed to a laser printer containing the desired paper style. Accounting departments can share the various printer resources needed to print invoices or checks. The flexibility of EZQueue can enhance productivity and reduce total system cost in virtually any workgroup environment.

Dynamic Buffering for Simultaneous Inputs
Buffering is dynamically allocated to one or more printer queues allowing simultaneous input from each of the attached computers with no waiting. When a shared printer is busy, files are stacked up in EZQueue's buffer and output to the designated printer when it is ready to receive the next file.

Multiple Printer Sharing
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CIRCLE 487 ON READER SERVICE CARD

Mannesmann Tally 87

With its $599 Mannesmann Tally 87 narrow-carriage dot matrix printer, Mannesmann Tally has taken a slightly different approach to a highly competitive printer market. While most single-user dot matrix printers have become smaller and lighter, the 55-pound MT 87 is a large machine with substantial parts.

Its features include a cast aluminum body, tilt-back top cover, front-panel menu-driven programming, and the ability to accept single-sheet paper or envelopes even when continuous-form paper is loaded. You can also use cartridge fonts to add personality to the printer's output. Print quality is good, and the MT 87's speed is consistent with its $599 price.

Actually the MT 87 looks faster than it is. While its speeds of 113 characters per second in draft mode and 33 cps in near-letter-quality mode are respectable, they're nothing to get excited about.

The MT 87's print quality is good but, again, not outstanding. The standard NLQ font resembles a Modern sans serif font to some extent; although it does have some serifs, it's fairly unadorned. We found the attractive Courier 10 font, available on an optional font cartridge, much superior to the standard NLQ font.

The optional font cartridges slide one at a time into a slot in the bottom-left front of the MT 87. Fonts currently available include Letter Gothic, Italics II, and Courier, each priced at $38.50.

The printer emulates the Epson FX-80 and the IBM Proprinter. It also prints the IBM high-order character set with the correct combination of menu settings. Fairly quiet, the MT 87 measured 69 decibels in draft mode and 67 decibels in NLQ mode.

Installing the MT 87 is somewhat cumbersome. First, you must install the printer interface board. Mannesmann Tally touts this necessary task as ensuring the printer's future adaptability, and it's right, but installing the interface board can be a nuisance nevertheless. At least the screws that you must loosen to remove the interface slot covering are captive, so you don't have to crawl all over the floor looking for them. The interface board slides into place securely, helped along by plastic guides.

Ribbon installation can be a bit messy, especially if you have one of a bad batch of ribbon cartridges that are about 1/16 inch too narrow. Once we had the proper cartridges, installing the ribbon was quicker, easier, and neater.

One of the MT 87's best features is its superior automatic paper-feeding mechanism, which smoothly advances paper to the right place. The paper tear-off design works well; you can avoid wasting paper because you can rip off a just-printed sheet without having to advance the paper a whole form's worth.

You also can feed single sheets or envelopes through the front while continuous forms are loaded. Paper-width guides help you to line up single-sheet paper. When you use this dual-paper mode feature, the continuous-form paper is pulled back to avoid wasting paper.

The MT 87 has no mechanical DIP switches. Instead, it uses a somewhat kludgy method of setting "switches" through front control-panel buttons that make menu selections of various printer configuration settings. The current settings of five sets of switches—a total of 34 little indicators—are printed on paper, and the paper rolls forward and backward as you move from one switch bank to the next, accepting or changing each setting. You have to consult the manual to make the adjustments, because each switch is identified merely as SW1-1, SW1-2, and so on, rather than by what the switch actually does.

The documentation for the MT 87 is fairly good, with separate applications and owner manuals. The manuals lack an index, but you do get a foldout quick-reference card, and the applications manual includes complete information on printer command control codes.

Mannesmann Tally has positioned the MT 87 as a high-quality executive or individual dot matrix printer. This serious printer isn't the one to choose if you want the smallest printer possible, but it offers superior paper handling, sturdy design, and good but not outstanding print quality and speed.—**Bruce Brown**

PC MAGAZINE FACT FILE



Mannesmann Tally 87
Mannesmann Tally
8301 S. 180th St.
Kent, WA 98032
(206) 251-5500
List Price: $599
Dimensions (HWD): 7.2 × 14 × 13.2 in.
Weight: 17.6 lbs.
In Short: This heavy-duty narrow-carriage 9-pin dot matrix printer, with 113-cps speed and several praiseworthy features, performs well in a highly competitive class.

CIRCLE 850 ON READER SERVICE CARD

Mannesmann Tally 90

Mannesmann Tally's narrow-carriage MT 90 ($799) doesn't have to try to be different; it's designed that way. A special type of ink jet printer, the MT 90 is a bubble-jet that prints good draft type at 101 characters per second—and quietly at that.

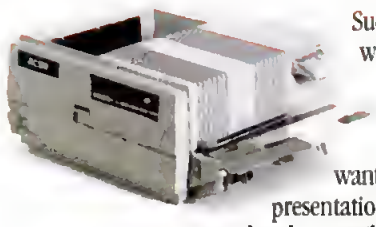
If noise is high on your list of considerations, the MT 90 should interest you. Its most endearing quality is that it operates so quietly you almost forget it's working.

The bubble-jet technology gets the credit. In the MT 90's on-demand system, tiny nozzles are rapidly heated when ordered to, producing bubbles whose rapid expansion forces the ink to eject. Other types of ink jet printers use either an on-demand mechanical pressure system or electrical charges to guide a continuous flow of ink. The advantage of the bubble system over other methods, according to Mannesmann Tally, is that it produces better print more quickly and without the threat of drips. The results of our tests bear out this claim.

Perhaps because it is so quiet, the MT 90 gives the impression that it works faster than it actually does. Besides its 101 cps in draft mode, it scored 74 cps in near-letter-quality mode. These speeds are certainly respectable, but nothing to crow about



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Standard Print Density Full Page Text	300 x 300 DPI	300 x 300 DPI
Graphics	300 x 300 DPI	150 x 150 DPI
Built-In Fonts	Nine	Six
Font Cartridges	Yes	Yes
Other Fonts	Third-party HP-compatible	Third-party HP-compatible
Vector Graphics	Yes	No
Engine	6ppm, Ricoh	6ppm, Canon
Engine Lifetime Rating	180,000 pages	Not listed
Warranty	One-year. Includes 4-month on-site service by TRW.	One-year Service at dealer location.
Suggested List Price	$2595	$2495 $2990*

*Price includes 1MB upgrade option for full-page, 300 x 300 DPI graphics capability offered standard by the ACER LP-75. HP retail cost–$495

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CIRCLE 218 ON READER SERVICE CARD

PC MAGAZINE FACT FILE



Mannesmann Tally 90
Mannesmann Tally
8301 S. 180th St.
Kent, WA 98032
(206) 251-5644
List Price: With parallel interface, $799; with serial interface, $849
Dimensions (HWD): 4.5 × 15.5 × 11.5 in.
Weight: 13.2 lbs.
In Short: A bubble-type ink jet printer that can emulate the IBM Proprinter, this narrow-carriage machine features low noise and also prints reasonably good type fairly quickly (101 cps in draft); for best results, you need to use clay-coated paper.
CIRCLE 461 ON READER SERVICE CARD

compared with those of many dot matrix printers at or below the MT 90's price.

The MT 90 uses both friction-feed and a nonadjustable pin-feed for loading paper. Its print quality is also fairly good, but not an award winner. You get the best results when you use the clay-based paper intended for this technology, since ordinary paper stock absorbs and spreads the ink that's shot at it. Nevertheless, even with standard paper the print is still good, allowing less bleeding than do some other ink jet printers.

The MT 90 offers few print features. The type sizes include 5, 8.1, 10, and 16.3 characters per inch; 12-pitch elite is not available. The print enhancements are bold, double-strike, underlining, and superscript and subscript—all controlled by standard IBM commands, since the MT 90 is compatible in print and graphics with the IBM Proprinter.

The quiet MT 90 registered only 59 decibels in NLQ and 61 decibels in draft. For people highly sensitive to noise, it's perhaps the next-best alternative to a laser printer, at about a third the price.

Installing the compact MT 90 is easy. The ink cartridge slides in behind a flimsy front panel. One ink cartridge has a rated life of 2.3 million characters in NLQ print and 6 million characters in draft. Replacement cartridges, available from the vendor, cost $16.

Besides the normal front-panel buttons for line-feed, form-feed, and on-line, back-panel slide switches let you select draft or NLQ print modes and switch between character sets 1 and 2. The latter settings determine both the actual character set and the page length. Changing from draft to NLQ print would be easier if the printer had a front-panel button to make the switch instead of requiring you to use the rear slide switches.

The MT 90's priming system uses both a priming lever and blinking lights to tell you how long to prime the printer. An interesting auto-capping system caps the print nozzles whenever 5 seconds of downtime pass. This system prevents the nozzles from drying out and becoming clogged; it also lessens the chances of ink leaking. For that reason you must be sure to wait at least 5 seconds whenever you have finished printing before you turn off the MT 90.

The MT 90's clearly written user and applications manuals include detailed discussions of printer control codes and interface specifications.

For the cost of the MT 90, you can buy many printers that print faster and with equal or better print quality. Yet the MT 90's quiet operation makes it stand out as an alternative to the buzzing of dot matrix printers or the banging of daisy wheel printers. It's especially suited for use in dorms and apartments and for small offices where keeping the peace is important.—**Bruce Brown**

Mannesmann Tally 330

The Mannesmann Tally 330—$1,799 from Mannesmann Tally—is a heavy-duty, high-speed dot matrix office printer. Setting up the 24-pin printer is a bit confusing if you try to follow the unclear documentation, but once the wide-carriage MT 330 is working, it performs well.

The line drawings in the Operator's Manual do a poor job of illustrating how to set up the MT 330. Also, the instructions for installing the ribbon and the wire paper guide are too sparse. On a positive note, the ribbon includes a nifty plastic device to push it behind the printhead. And while the instructions for using the printer's powerful front-panel Menu mode are just adequate, the Applications Manual includes good guidelines on how to program the printer's features.

You can select most of the MT 330's many features by using both software and the printer's front panel. The panel has four off-line modes: local, test, pq, and menu. Local mode is used to advance or retract paper, test mode runs any of three printer self-tests, and pq mode sets the current print quality. Menu mode opens two dimensions of control, called User and Technical Menus.

For both menus the MT 330 prints cur-

PC MAGAZINE FACT FILE



Mannesmann Tally 330
Mannesmann Tally
8301 S. 180th St.
Kent, WA 98032
(206) 251-5500
List Price: $1,799; with parallel or serial interface and auto-tractor feed, $1,878; for color model with interface and auto-tractor, $2,007; auto-dual-bin sheet feeder, $499; serial interface in addition to parallel, $79; current loop interface, $129.
Dimensions (HWD): 6 × 23.75 × 16.9 in.
Weight: 55 lbs.
In Short: This high-speed (190-cps), 24-pin wide-carriage dot matrix printer is designed for heavy-duty office printing; its performance and features match the superior design.
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rent settings on paper, and you use the front-panel buttons to select new settings. Using the Technical Menu, you can change any of the settings on the Technical Listing: communications interface and parameters, paper feed, emulation modes, and minor left/right printhead adjustment. Through the User Menu you can set characters per inch, font, character presentation, national character set, lines per inch, paper length, perforation skipping, line length, left and right margins, and both vertical and horizontal tabs. If they are present, you can also select printer and ribbon options from the User Menu.

The MT 330 allows you to choose among levels of print quality and speed. You have your choice of three print modes: draft, near letter quality, and letter quality. All three modes print 10, 12, and 15 characters per inch; the draft and NLQ modes also print 17 cpi. According to Mannesmann Tally, font cartridges will be available in the last quarter of 1987, should you want to augment these modes.

The MT 330's LQ print is clearly better than its NLQ print, but the NLQ print could pass for the LQ that lesser dot matrix printers offer. On the other hand, the MT 330's best mode, LQ, will never fool anyone: although the output is very good, you can tell it's from a dot matrix printer. If you don't need daisy wheel or laser quality type, you'd probably be more than happy with the MT 330's three levels of print quality.

Speeds were respectable on the PC Labs tests: draft at 190 characters per second, NLQ at 112 cps, and LQ at 67 cps. While a few dot matrix printers can print faster than the MT 330, most can't print at such high speeds in all modes.

And while the MT 330 prints quickly, it doesn't make much noise. Our readings consistently topped out between 71 and 72 decibels regardless of print mode.

Two emulation modes are standard, ANSI and IBM. The MT 330 passed our emulation tests for both text and graphics for the IBM Proprinter and the Epson FX series of printers. The Technical Menu also lists Diablo 630 emulation, which will be available in the last quarter of 1987. A color option is currently being sold.

The Mannesmann Tally 330 deserves a place on the current list of high-performance dot matrix printers. Its features, speed, and rugged design demonstrate a commitment to quality.—**Bruce Brown**

NEC Pinwriter P9XL

For $1,795, the NEC Pinwriter P9XL, from NEC Information Systems, offers a little bit of everything: a high-speed draft mode, a high-quality near-letter-quality mode, and color printing. The 24-pin dot matrix printer even offers both italic and the IBM high-order character set. Most important, the NEC Pinwriter does everything well, making it a jack of all trades and master of many.

Print quality on the NEC Pinwriter ranks among the best available from dot matrix printers. Taking a hint from full-formed character printers, NEC offers a carbon ribbon for highest-quality output. The carbon ribbon, in combination with the 24-pin printhead, delivers solid, dark text and graphics.

Text output in NLQ mode can almost pass for true letter quality. The characters betray their dot matrix source only by a slight blurriness around the edges, which is apparent only if you look closely. The high-quality print is particularly impressive considering the 90-character-per-second tested speed for NLQ mode on the PC Labs speed tests. However, that rating is for wide-carriage printing. On letter-size documents, the speed drops to a still-impressive 83 cps.

Even draft mode on the NEC Pinwriter is solid and readable. In fact, it's good enough to qualify as correspondence quality. PC Labs speed tests clocked the draft mode at 157 cps for wide-carriage printing and 138 cps for letter-size printing.

Unfortunately, high-speed draft mode deteriorates to a level that courts eyestrain for extended reading. Perhaps that's only to be expected, but given a clocked speed of 170 cps, the loss in readability doesn't seem worth the 13-cps gain in speed.

The quality of graphics output on the NEC Pinwriter is also impressive. The carbon ribbon and the 24-pin printhead can take the credit for the dark, crisp graphics. If graphics output is important for you, this printer won't let you down. Solid bars are black, and patterns retain all their detail.

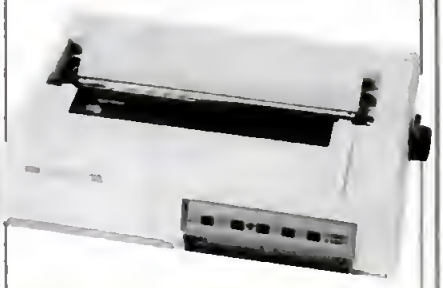
A change in ribbon brings the NEC Pinwriter into the world of color, using the Epson JX-80 command set. The color feature works well enough, but the quality is simply not up to the black-and-white graphics. If you look closely at the color output, you will be able to see individual print lines.

The NEC Pinwriter is louder than you might like. We measured it at 69 decibels in NLQ mode, and the sound had a deep buzzing quality. Draft and high-speed draft mode are quieter at 68 decibels but less pleasant, since the printer switches to a high-speed whine. In the quiet mode the print speed drops by half.

The NEC Pinwriter is solid looking, but it won't win a place in the Museum of Modern Art. In this case, function is more important than form. The printer's five-button front panel lets you choose font, print quality, and quiet mode, as well as the usual line-feed, form-feed, and on- and off-line functions.

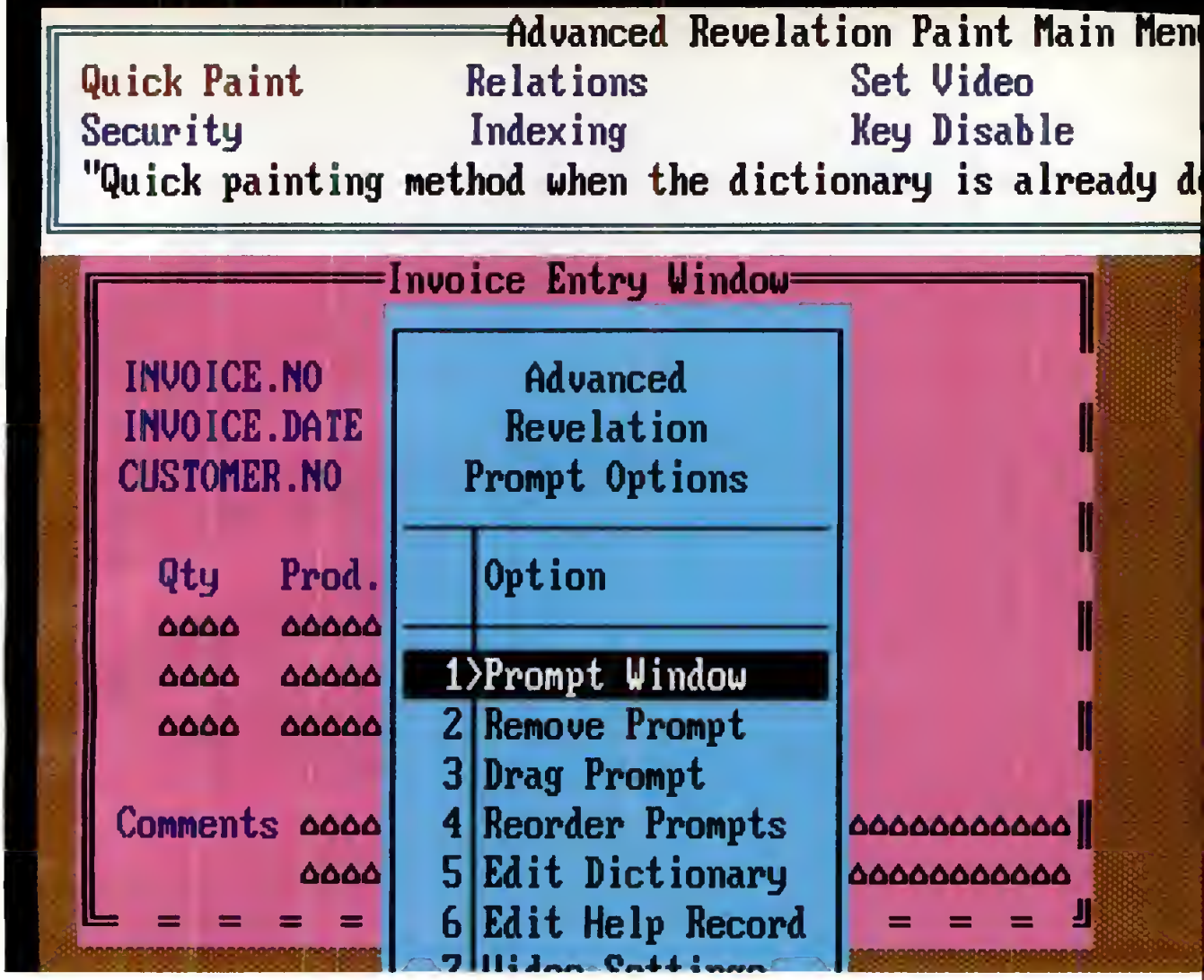
Installing and using the NEC Pinwriter is reasonably simple. The printer comes

PC MAGAZINE FACT FILE



NEC Pinwriter P9XL
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 343-4418
(617) 264-8635 (in Mass.)
List Price: $1,795
Dimensions (HWD): 6.1 × 14.7 × 22.8 in.
Weight: 37.4 lbs.
In Short: This wide-carriage 24-pin dot matrix printer offers a lot: speeds from 90 (NLQ) to 170 (high-speed draft) cps, NLQ mode that verges on true letter quality, unusually high-quality black-and-white graphics, and color as well.

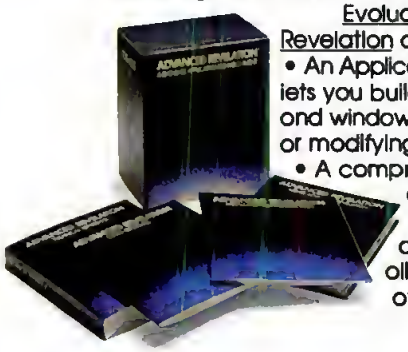
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CIRCLE 721 ON READER SERVICE CARD

with its DIP switches set for Epson LQ-1500 compatibility. To use the printer this way, you only have to set up the printer and install your software for the Epson LQ-1500. If you'd rather use the Diablo 630 mode, you change one DIP switch and install your software accordingly.

The NEC Pinwriter's paper-handling features are a mixed blessing. As shipped, the printer comes with a cut-sheet guide. The guide makes it impossible to use continuous-form paper—a problem because when you remove the cut-sheet guide from the printer, the NEC Pinwriter won't operate unless you install one of the "optional" paper-handling features. So for long-distance printing (using continuous paper), expect to spend an additional $179 for the bidirectional tractor feed, $395 for the single-bin sheet feeder, or $650 for the double-bin sheet feeder. Notably, an envelope feeder option is unavailable.

Two well-written and well-illustrated manuals come with the printer. The user guide will show even the most novice user how to set up the NEC Pinwriter in minimal time. The far-thicker reference manual includes DIP switch settings and control codes.

The NEC Pinwriter P9XL has much that is good and little that is not. You can find both faster printers for the price and printers with better print quality. But there are few printers that can offer the NEC Pinwriter's combination of text quality, speed, graphics quality, and color. If you need one printer to do it all, the NEC Pinwriter P9XL is a good prospect.

—M. David Stone

Nissho NP-2405

My initial unfavorable reaction to the $1,295 Nissho NP-2405, from Nissho Information Systems, proves the fallibility of first impressions. A rather large and ungainly 24-pin dot matrix printer, the narrow-carriage Nissho NP-2405 slopes sharply from the back at an angle any skier would be eager to try out. Its front printhead cover is off-putting as well, showing a confusing map of all the programmable functions available.

The printer is not easy to set up, and the badly edited manual does not help matters. For example, clear instructions would make it easier and less time-consuming to set up the tractors, which can be configured differently depending on whether you are using cut sheets or forms, and whether you want forms pushed or pulled through the machine.

However, once the printer is ready to go, you can forget those inconveniences and focus instead on the Nissho NP-2405's strength: programmability. By using several switches, you can select the features for just about any configuration you might need, including five different type styles in a variety of pitches, italic and boldface, margins, page length, and feed, among others.

You program the Nissho NP-2405 by using a keypad located below the printer's small LCD screen. Along with power and on-line LEDs, the keypad includes reset and reverse buttons. Three additional buttons do double duty as the on-line, form-feed, and line-feed buttons; in programming mode, they are called "Step1," "Step2," and "Step3," respectively.

PC MAGAZINE FACT FILE



Nissho NP-2405
Nissho Information Systems
10855 Business Center Dr., #100
Cypress, CA 90630
(800) 952-1919
(800) 443-9998 (in Calif.)
(714) 952-7800
List Price: $1,295
Dimensions (HWD): 9.5 × 23 × 19 in.
Weight: 33.3 lbs.
In Short: An excellent 143-cps narrow-carriage 24-pin dot matrix printer that is easy to program and offers good quality print in a variety of fonts.

CIRCLE 548 ON READER SERVICE CARD

To change the printer's configuration, you place the Nissho NP-2405 off-line and press the reverse and reset buttons. This step sets the printer in programming mode, which is completed when the LCD screen flashes "FUNCTION SET" and then "USER SET."

Three user sets are available, all of which can be assigned a variety of format options; thus, instead of having to reprogram the printer for, say, 8-pitch Italic Century PS, you can assign that font to a specific USER SET and call on it whenever you wish.

Assigning a font to a USER SET is easily done. Once you reach the desired USER SET, you press the Step1 button again to scroll through the major function categories: print style, format, default set, feed option, and others (auto-line-feed, bell on/off, etc.). When you find the category you want, you press the Step2 button to add features from subcategories. For example, the PRINT STYLE category will lead you to such subcategories as italic, bold, and font. Pressing the Step3 button changes the setting for a subcategory. Hitting the reset button makes your choices part of the printer's routine, even saving your selections after you turn off the printer.

Programming aside, the Nissho NP-2405 is an excellent printer. Satisfactorily fast, it runs at 143 characters per second in draft mode and at 65 cps in NLQ mode. Especially impressive is the quality of the Nissho NP-2405's Century PS and Gothic fonts. Both are clear, crisp, and about as close to laser printer output as you're going to get from a dot matrix printer. The Courier 10 NLQ font is also well defined, if a little heavy for my taste. Proportional spacing, which seems to have its own font, is also fine. My only complaint is with the DP 10 draft print, which is too light and broken to be easily readable. It's the only disappointment in an otherwise superb printer.

All in all, the Nissho NP-2405 is an excellent machine for a variety of business uses—just what you'd expect for $1,295. Of course, there are a few things that Nissho could work on—like its draft font and those less-than-clear assembly instructions. But these are minor problems in what is definitely a major printer.

—Barbara Krasnoff

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Okidata Microline 393

If can you believe Okidata's sales pitch, the company's Microline 393, a wide-carriage 24-pin dot matrix printer, offers high speed, excellent print quality, high-resolution graphics, versatile paper handling, and the ability to change quickly and easily among applications—all for $1,399. Yeah, that's the ticket.

It's all true. This impressive printer is an advertising agency's dream. In action, it backs up the manufacturer's claims.

The Okidata Microline 393 offers four levels of print quality: letter quality mode, near-letter-quality mode, utility mode (actually draft mode), and high-speed draft mode. The NLQ mode is essentially correspondence quality intended to be used for internal memos.

Output in all four modes is acceptable or better. Letter quality output is highly readable, with solid, dark, well-formed characters. You have to look at it closely to be able to tell that it came from a dot matrix printer. NLQ output is also dark, but it uses the thin typeface that comes only from a 24-pin printhead.

Also, the Microline 393 produces highly readable output in both utility mode and high-speed draft mode. Characters produced in utility mode are nearly identical to those produced in NLQ mode, except that they are not as dark. In high-speed draft mode, which works only at 15 or 17 pitch, the characters are necessarily smaller than usual, but the output is no harder to read than in draft mode.

Okidata claims speeds that range from 120 cps for letter quality to 450 cps for high-speed draft mode. On the PC Labs speed tests, the printer showed up at a respectable 83 cps for letter quality, 111 cps for near-letter-quality, 170 cps for utility, and 216 cps for high-speed draft.

The printer's graphics work just the way they should. The Microline 393 passed the Epson LQ-1500 graphics emulation test without problems, producing better-than-average graphics. The output is not as dark as you'd ideally like, but solid bars are solid and patterns show all their detail.

With dot matrix printers, high speed often means a high noise level. Yet the Microline 393 makes a surprisingly pleasant office companion, producing a smooth hum rather than a high whine. It measured a comfortable 72 decibels on the PC Labs sound test. You can get quieter operation by hitting the "quiet" button on the front panel, which slows the printer down somewhat.

The Microline 393's paper handling is another of its selling points. The built-in tractor-feed sits in back of the roller and pushes paper forward. Once you've loaded paper into the printer, you can hit the top-of-form button while the printer is online to back the paper out of the roller and out of the way. You can then feed envelopes or single sheets as needed. When you're finished, you need to hit only the form-feed button. The printer will roll the tractor-feed paper back into the roller and automatically position it correctly.

Besides the built-in push tractor-feed, Okidata offers an optional external pull tractor-feed for the Microline 393. When used in combination with the bottom feed slot, the external tractor will let you feed heavyweight cards without bending them around the roller and increasing the likelihood of paper jams. One- and two-bin sheet-feeders are also available. According to Okidata, both sheet-feeders can feed envelopes as well as paper.

> The Microline 393 offers four levels of print quality: letter quality mode, near-letter-quality mode, utility mode, and high-speed draft mode.

The Microline 393 has a less massive look than you might expect from a heavy-duty dot matrix printer, but that's not for lack of toughness. Okidata, known for its rugged machines, claims that the printer uses special alloys in the printhead pins and proprietary technology for durability.

The most striking aspect of the Microline 393's good looks is its front panel. The printer has enough touch-sensitive buttons and colorful lights to serve as a set designer's idea of a control panel for an updated Starship *Enterprise*. In addition to the usual line-feed, form-feed, top-of-form, and on-line switches, you'll find buttons for setting character pitch, print quality, font (resident, downloaded, or font cartridge), and quiet operation.

By having these controls easily accessible on the front panel, the Microline 393 saves you from having to send software commands or work your way through the stored settings menu just to change print mode—unquestionably a convenience. And the ease of changing modes makes it far more likely that you'll take advantage of the printer's features.

By any measure, the Okidata Microline 393 is an excellent machine, hard to beat for anywhere near its $1,399 price. One of the few features it lacks is color printing, but a color model is available for an additional $100. If you're serious about finding a fast, heavy-duty printer that can handle many tough printing assignments well, the Okidata Microline 393 is the ticket for '88.—**M. David Stone**

PC MAGAZINE FACT FILE



Okidata Microline 393
Okidata
532 Fellowship Rd.
Mount Laurel, NJ 08054
List Price: $1,399
Dimensions (HWD): 8 × 26 × 20 in.
Weight: 37 lbs.
In Short: This wide-carriage 24-pin dot matrix printer offers an impressive combo: high speed (170 cps in utility and 216 cps in high-speed draft), good print and graphics quality, and ease of use.

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Olympia NP30

Today with so many dot matrix printers sporting such attention-getting features as LCDs, programmable fonts, and color ribbons, a decent no-frills printer can easily get lost in the shuffle. In that regard, the $299 Olympia NP30, from Olympia USA, is a real find.

The Olympia NP30 is a lightweight but sturdy 9-pin narrow-carriage printer that produces draft and near-letter-quality type in a variety of formats. Even the manual is straightforward and easy to understand: shorter than most, it doesn't include the typical self-congratulatory phrasing but explains the printer setup and control codes clearly and precisely.

Three separate covers for the printhead, the platen, and the paper separator come with the Olympia NP30. It uses a clam cartridge ribbon, which is quite easy to install. Membrane switches located on the front left side are labeled select, line-feed, form-feed and NLQ on/off. To use line-feed or form-feed, the select switch must be off; however, you can switch to or from NLQ mode at any time—even while you're in the middle of printing a document. If you do plan mid-page switches, keep the buffer in mind; if you're printing in NLQ mode and a lot of data has already been fed into the printer, pressing the switch again won't do much good.

Olympia has made its DIP switches (at least, the ones most likely to be used) very accessible. Situated behind a small sliding door to the left of the switch panel, these DIP switches control the auto-sheet-feeder, page-end sensor, Epson and IBM emulation modes, and other functions. Functions less likely to be changed, such as the international character set or slashed zero, are controlled by DIP switches on the printer's main board, which is located beneath a cover on the back of the printer.

I was a bit apprehensive when I found that the printer loads paper under rather than over the platen—a system that is awkward at best. Rather than adjusting the pin-feeds directly to the paper, you must set them to numbered markings on the printer's metal paper guide, and then scroll the paper through manually, hoping that the internal pin-feed will catch the holes properly. In this case, though, I was pleasantly surprised: the paper fed without any problem and did not slip during testing. However, it's advisable to make sure the paper has scrolled past the sound cover before printing; otherwise the leading edge of the paper tends to catch inside the cover.

The print quality of the NLQ is acceptable for limited business and home use. The letters are rounded, even, and quite good for a 9-pin printer. Output is clear and readable, although on closer examination it's obvious that it comes from a dot matrix printer. The draft type is acceptable, but only just; the separate dots of each letter are clearly visible, and there is some variation in the darkness of the print.

The NP30 had no problem producing any of the printing and formatting enhancements called for by the PC Labs tests. Proportional type automatically comes out emphasized. The printer also had no trouble coping with our graphics emulation test.

As far as speed goes, the NP30 is definitely not a front-runner. The draft mode trots along at a reasonable 93 characters per second, but in NLQ the printer slows down to a leisurely stroll at 25 cps. However, the NP30 does its part in keeping noise down, producing a low-pitched rumble at 73 decibels in draft.

The Olympia NP30 is an acceptable no-frills printer for users who need a second, inexpensive machine for drafts and memos. But if you need to go beyond those limited tasks, you might be better served by a faster, more fully fledged business printer.—**Barbara Krasnoff**

FACT FILE



Olympia NP30
Olympia USA Inc.
P.O. Box 22
Somerville, NJ 08876-0022
(201) 231-8300
List Price: $299
Dimensions (HWD): 3.75 × 16.5 × 13.25 in.
Weight: 14.5 lbs.
In Short: A sturdy 9-pin narrow-carriage dot matrix printer that is adequate for memos and drafts but, at 93 cps in draft, is too slow for heavy corporate use.

CIRCLE 609 ON READER SERVICE CARD

Olympia NP80 and NP136

Olympia USA's $499 NP80 and $649 NP136 are narrow- and wide-carriage versions of the same dual-mode 9-pin dot matrix printer. They offer both Epson FX and IBM Proprinter modes, a built-in tractor, and optional font cartridges. Although the NP80 and the NP136 do not advance the state of the art, they print legible copy in draft mode at a respectable rate—142 and 140 characters per second, respectively—and are affordable.

Installing the printers couldn't be easier. It's a simple matter of snapping in an Epson-like ribbon cartridge and connecting both the power cable and the cable to the parallel port. (A serial interface is available for an additional $50.)

Loading continuous forms requires that you raise the built-in tractor so that the paper can slip beneath it to get to the platen. By turning the platen knob, you feed the paper through the path until it appears in the front. At that point you need to snap the tractor back into position, feed the paper some more, align the perforation holes with the sprockets, and close the sprocket covers.

While the process is similiar to that used by some other dot matrix printers, the result is not. When you turn the NP80 and the NP136 on, the lack of space beneath the tractor occasionally creates enough tension on the paper to cause paper jams and tear perforations.

FEATURES AND CONTROLS Besides the usual on/off-line, form-feed, and line-feed controls, the NP80 and NP136 front

PC MAGAZINE FACT FILE



Olympia NP80 and NP136
Olympia USA Inc.
P.O. Box 22
Somerville, NJ 08876-0022
(201) 231-8300
List Price: NP80, $499; NP136, $649; serial interface, $50
Dimensions (HWD): NP80, 4.4 × 17.1 × 13.6 in.; NP136, 4.4 × 24.1 × 13.8 in.
Weight: NP80, 17.6 lbs.; NP136, 22 lbs.
In Short: This 9-pin dot matrix printer, in narrow- and wide-carriage models, emulates the Epson FX and IBM Proprinter printers and accepts optional font cartridges; draft speed is 142 cps for the NP80 and 140 cps for the NP136.
CIRCLE 634 ON READER SERVICE CARD

panels sport touch-sensitive switches for selecting near-letter-quality mode and character pitch. Pica, elite, condensed, and proportionally spaced type are available. The pitch LEDs, when blinking and accompanied by the alarm, also double as error message lights.

You can arrange certain features as the default configuration by toggling the easily accessible DIP switches at the rear of the printers, just above the parallel port controller. Among the features you can enable are emulation mode; draft, emphasized draft, or near-letter-quality; slashed zero; the auto-sheet-feeder; and activation of the input buffer and paper-out detector.

Like the IBM Proprinter and Epson FX printers that they emulate, the NP80 and the NP136 allow you to mix and match features. For example, you can use NLQ in conjunction with all the character pitches except condensed print.

Unlike the NLQ fonts on the newer IBM and Epson models, though, the Olympia printers' NLQ font is not especially well formed. While the NLQ characters are filled in better than those in the draft font enhanced with double-strike, you can still see evidence of the individual dots that make up each 18- by 24-dot character. But any printer that will give better quality is probably going to cost more, especially for a wide-carriage version like the NP136.

TESTED RATINGS The NP80 and the NP136 passed the PC Labs graphics and text compatibility benchmark tests. They also can print all the characters in the IBM character set.

Speed tests showed that the NP80's draft output is 142 cps and the NP136's is 140 cps (142 cps printing on letter-sized paper). The NLQ mode tested at 40 cps for the NP80 and 39 cps for the NP136. The NLQ speeds of both printers are extremely close to Olympia's own rating of 40 cps, and the draft speeds are only about 25 percent less than the factory-rated 200 cps. While the speeds are not especially high in today's world of speed-demon printers, neither are they far from the norm. For both the NP80 and the NP136, sound level tests produced a rating of 75 decibels in draft and 74 in NLQ.

At first glance, the printers' 7- by 10-inch, spiral-bound manual looks unprofessional, even childish. Once you delve into it, though, you'll find its organization and contents more than adequate and, at times, quite impressive. The manual makes up for the lack of an index with a detailed table of contents, appendixes, and tabs for the major sections. It clearly labels the escape code sequences and includes the actual code sequence, syntax examples in BASIC for both hexadecimal and decimal, and remarks explaining each code's function, its effect, and a referral to its counterpart. Sample programs and printouts accompany many of the codes.

Looking for an inexpensive printer with both Epson and IBM compatibility? Put Olympia's NP80 or NP136 on your list. Although the way they load continuous forms may not be the most elegant and their NLQ print may not look like that of a daisy wheel, these machines print fast in draft, pass the compatibility tests for Epson FX and Proprinter emulations, have a comprehensive manual, and are priced right. The NP136, in particular, is an especially good buy for a wide-carriage printer.—**Vincent Puglia**

OTC TriMatrix 850XL

At the hefty price of $2,395, the wide-carriage OTC TriMatrix 850XL, from Output Technology Corp., raises a lot of expectations. With its patent-pending TriMatrix—or three-printhead—design, it offers a new printing technology that raises expectations still further. But it's a difficult printer to evaluate. Does it deliver? Well, that depends.

On the plus side, the 9-pin triple-headed TriMatrix 850XL is fast—make no mistake about it. In our tests it output 307 characters per second in draft mode and 53 cps in near-letter-quality mode. Output Technology claims 544 cps in draft and 72 cps in NLQ. But never mind the difference in results here: the TriMatrix 850XL prints 240 lines per minute, and that's about as fast as any dot matrix printer gets.

PC MAGAZINE FACT FILE



OTC TriMatrix 850XL
Output Technology Corp.
E. 9922 Montgomery, #6
Spokane, WA 99206
(800) 422-4850
(509) 926-3855
List Price: $2,395
Dimensions (HWD): 6.3 × 27.38 × 16.7 in.
Weight: 41 lbs.
In Short: This wide-carriage, 9-pin, triple-head dot matrix printer outputs 307 cps—wow!—in draft. Its text print is great looking, but graphics from a printer so costly should look better.
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Furthermore, the TriMatrix 850XL is an excellent text printer. Its strong NLQ output looks as if it comes straight from a typewriter. The draft-mode characters are barely recognizable as the work of a dot matrix printer.

Despite its rather steep price, the TriMatrix 850XL lacks two essential type enhancements—italic and proportional spacing. Also on the negative side, the TriMatrix 850XL, emulating the Epson FX-100, performs poorly as a graphics printer. The circle it produced for our test was distorted, and the lines that ran diagonally across the circle were broken and parted at the top and the bottom. Further, the tower of patterns that the TriMatrix 850XL produced was tilted overall and split at specific grid points. The patterns themselves, however, were right on the mark—clear and elegant.

The TriMatrix 850XL has an unusual configuration method for choosing character, format, and serial options as well as selecting the emulation mode. To configure the printer, you answer questions that the printer prints out on a sheet of paper. For instance, the printer types, "Set Character Options?" To respond yes, you press line-feed; to respond no, you press form-feed. After all the battles with DIP switches and front control panel configuration schemes that so many other printers subject you to, this technique is remarkably fresh and creative.

But there's a problem with this innovative approach: it's impossible to read the questions without leaning way over the machine and staring down into its print mechanism. If you look at the TriMatrix 850XL from the front, the paper on which it prints the questions is buried behind the top cover. Okay, so you can lift the top cover and read the configuration queries. Good idea, but the printer goes off-line when you raise the top cover, and you can't respond to the configuration questions without closing the cover again. All this opening and shutting of the cover almost leads you to wish that Output Technology had stuck to the old-fashioned, working-class method for configuring the printer.

Another quirk of the TriMatrix 850XL that some people may find annoying is that it has no platen knob. You cannot roll the paper up or down manually but only by using the form-feed, line-feed, or microspacing controls. If you like adjusting the paper by hand you may feel handicapped—unlike those modem folks who view platen knobs as unnecessary holdovers from the age of typewriters.

The well-written user manual is particularly impressive. Each control code for accessing printer functions or type enhancements appears on a separate page, illustrated by a BASIC program.

The TriMatrix 850XL raises expectations as high as its price and delivers its promise for some but not others. With turbo speed and great text output on one side, poor graphics and some annoying design elements on the other, it's tough to tag. If you're looking for speed, it delivers. Boy, does it deliver! But if you place a premium on graphics, it doesn't. You decide.

—Jeffrey Rothfeder

Panasonic KX-P1080i

With the $269 Panasonic KX-P1080i, Panasonic Industrial continues its tradition of beating the competition in price, which adds instant allure to its products. And once the Panasonic KX-P1080i has your attention, the 9-pin dot matrix machine proves that it can compete with, though perhaps not surpass, any of the slightly more expensive printers in its class.

Designed for the light-duty home and school, the narrow-carriage printer has two fonts: pica and elite. It enhances them with excellent versions of bold, underline, italic, and proportional type. In addition, the Panasonic KX-P1080i's near-letter-quality mode is first-class. The letters are stark and thick, and not as blotchy as the NLQ output of some dot matrix printers. The draft mode is less impressive; the lower part of the characters looks a bit soft.

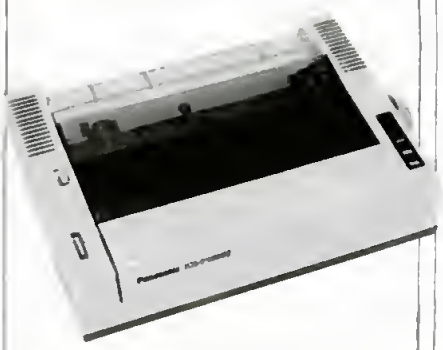
Emulating the Epson FX-100 or the IBM Graphics Printer, the Panasonic KX-P1080i is a workmanlike graphics machine. While the circles it prints appear a bit shaky and over-inked at the circumference, the patterns and lines it produces are true and well rendered.

The PC Labs speed tests results were respectable for a low-end printer: 90 character per second in draft mode and 23 cps in NLQ. The sound level for draft mode was 74 decibels.

Besides its competitive price, the Panasonic KX-P1080i has another characteristic Panasonic attribute: its high-quality user manual. The carefully crafted 100-plus pages explain step by step, in easy-to-understand terms, how to set up the printer and use the programming control codes. The manual gives both sample BASIC programs and examples of the type enhancements. What's more, numerous appendixes repeat essential information, organized and condensed in tables. And an index cross-references the text. Panasonic deserves kudos for this documentation.

Panasonic also deserves praise for its excellent technical support staff, reached by calling a toll-free number. The representatives we spoke to not only knew the printer well but also answered questions with courtesy and aplomb. This service adds immeasurably to the value of a basic machine like this one, which is likely to at-

PC MAGAZINE FACT FILE



Panasonic KX-P1080i
Panasonic Industrial Co.
Division of Matsushita Electric Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
(201) 348-7000
List Price: $269
Dimensions (HWD): 4.5 × 16 × 11.25 in.
Weight: 13.2 lbs.
In Short: This 91-cps, narrow-carriage, 9-pin dot matrix printer performs on a par with printers costing $50 to $100 more.

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CIRCLE 372 ON READER SERVICE CARD

tract many users who are new to the printer market.

The Panasonic KX-P1080i is a competitive performer with an unbeatable price. What's more, you can depend on it to handle basic, low-end printing tasks well over the long haul, whether in a home, school, or small-office setting. And you can depend on Panasonic to support you—in the guise of the user manual and in the person of its technical staff—in getting the most from the printer.—**Jeffrey Rothfeder**

Panasonic KX-P1091i

Panasonic and Epson are like the Pepsi and Coke of Japanese printer manufacturers: they're both tough competitors, and some of their contests are equally tough to call. But Panasonic is more than a contender with its Panasonic KX-P1091i. Recently reduced to $289 list and available from at least one well-known discounter for $100 less, the Panasonic KX-P1091i clobbers the competition in the inexpensive, narrow-carriage 9-pin dot matrix market.

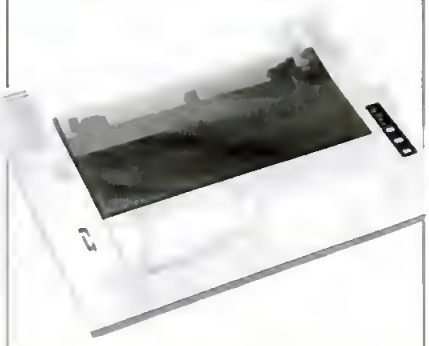
Anyone who has watched Panasonic's ascendance in the printer market won't be surprised by the KX-P1091i's triumphant performance, price, and ease of use. The sturdy Epson look-alike, which emulates both the Epson RX-80 and the IBM Proprinter, has an auspicious heritage. It's the latest version of the KX-P1091, a *PC Magazine* Editor's Choice when M. David Stone reviewed it for the 1985 printer roundup (Volume 4 Number 19, pages 103 to 104).

Proof positive that there's always room for improvement, the Panasonic KX-P1091i not only offers more features and fonts than its acclaimed predecessor, as well as an improved front control panel—but it's also faster, quieter, and—remarkably—cheaper. With print speeds and noise levels of 99 characters per second and 71 decibels in 10-pitch draft, as well as 28 cps and 69 decibels in 10-pitch Courier near-letter-quality, the Panasonic KX-P1091i outperforms its predecessor. And it can go the distance faster and with less fuss than a number of the other, more expensive, 9-pin dot matrix printers reviewed here.

Right out of the box, the Panasonic KX-P1091i looks like a winner. Its streamlined design, its clearly labeled line-feed, form-feed, and on-line push buttons, and its paper-out, power, and on-line indicator lights are the first gratifying indications that this champ is on your side. The line-feed and form-feed controls work whether the printer is on-line or off-line.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Panasonic KX-P1091i
Panasonic Industrial Co.
Division of Matsushita Electric Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
(201) 348-7000
List Price: $289
Dimensions (HWD): 4.4 × 15.8 × 11.25 in.
Weight: 15.2 lbs.
In Short: A tough competitor in the 9-pin class, this super dot-matrix narrow-carriage printer is versatile, easy to use, and fairly speedy in draft (99 cps). Its near-letter-quality print makes the grade, but nothing could be more impressive than its hard-to-beat price.

CIRCLE 689 ON READER SERVICE CARD

The print mode selector switch and the paper-feed selector cast the Panasonic KX-P1091i in an even better light. You can select draft, Courier NLQ, and bold NLQ in proportional spacing, and choose compressed print simply by changing the switch settings, both when the printer is off-line and on-line. And you can use either single sheets or fanfold paper, since the printer has both a friction and a tractor mechanism for feeding the paper.

The ease with which you can install the ribbon cartridge and load the paper scores more points for the Panasonic KX-P1091i. In fact, you'd probably be able to install and operate the Panasonic KX-P1091i in its standard Epson-emulation mode even without consulting the clear, comprehensive operating instructions. Alternatively, you can change to IBM Proprinter mode to access the IBM low- and high-order character sets by adjusting the DIP switch settings inside the front cover and by using the software commands that the instructions detail so thoroughly.

The Panasonic KX-P1091i's bit-mapped image graphics mode lets you create graphics designs in a full range of densities. All the high-order characters are available. In addition, you can design characters and download them into the printer's memory, which can store up to 40 characters in Epson mode and up to 32 characters in IBM mode.

Print quality in draft mode is one notch above the usual connect-the-nine-dots output produced by this type of printer, and the Courier NLQ print could go a few rounds with the best typewriter output. Both draft and Courier NLQ are available in 10 pitch, 12 pitch, 15 pitch (semicompressed), and 17 pitch (compressed); you can easily print a good-looking spreadsheet. Bold PS mode produces bold proportional NLQ print that looks great in headlines. Both the Courier NLQ and Bold PS fonts can produce italic.

In all, the packaging and pricing of the Panasonic KX-P1091i are good examples of how to make and sell a hard-to-beat competitor: imitate the best of your competition, eliminate the worst, add value, offer support, make your product easy to use, and price it under all the rest.
—**Carol Olsen Day**

Panasonic KX-P1092i

Panasonic's $499 9-pin dot matrix printer, the Panasonic KX-P1092i, is the kind of hardworking machine that your office could buy when times are lean and then keep forever as a backup even when the profits are rolling in. And while it's not perfect, its flaws number so few that you may not care.

Just 1 or 2 years ago the Panasonic KX-P1092i's combination of speed and print quality would have been amazing at the price. In today's market it is still better



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Division of Matsushita Electric Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
(201) 348-7000
List Price: $499
Dimensions (HWD): 5.4 × 15.3 × 13.8 in.
Weight: 21.8 lbs.
In Short: This 9-pin, narrow-carriage dot matrix printer offers both Epson FX-80 and IBM Proprinter emulations with respectable speed (113 cps); if you can tolerate the insistent error beeping, the printer is well worth the price.

CIRCLE 545 ON READER SERVICE CARD

than average. The vendor's claimed speed of 240 characters per second for draft mode translates to a measured speed of 113 cps on PC Labs speed tests. The claimed 48 cps for the printer's near-letter-quality mode translates to a measured speed of 37 cps.

More important than speed is the quality of output. With draft mode you can see the individual dots without much trouble, but the print is nevertheless highly readable. In NLQ mode the characters are less crisp than those produced on a good typewriter, but still solid and dark.

A bold proportional space mode, Bold PS, is darker still. With a measured speed of 38 cps, it's even slightly faster than the Courier NLQ mode. Yet the spacing on the Bold PS is less than ideal, with too much space around some characters. The result is less aesthetically pleasing than it might be, but still clear and easy to read.

Graphics output falls short of the text output quality but is still more than suitable for casual graphics use. In the PC Labs test the Panasonic KX-P1092i emulated both the Epson FX-80 and the IBM Proprinter without problems. Unfortunately, the output lost detail in the more intricate patterns.

Setting up and learning how to use this printer is more difficult than it should be, partly because of the manual and partly because of the printer itself. The manual unnecessarily confuses you by referring to the Epson FX-80 emulation as standard mode. How can you install your software properly unless you know what emulation the printer is using?

The manual also intermixes both Epson FX-80 and IBM Proprinter command codes in the same list, since many of the commands are shared by the command sets. Unfortunately, intermixing the codes increases the chances that you'll pick the wrong one. Two separate lists would be far better.

The Panasonic KX-P1092i itself makes obscure use of the front-panel LEDs. A front-panel switch makes it theoretically easy to set pitch and print quality, but the indicators use just three lights to indicate seven different print modes. With practice, you can learn to decode the meanings of different combinations of lights, but the first few times you try, it's mystifying. I'd rather the printer cost a little more and gave me separate, clearly labeled status lights.

On the plus side, the Panasonic KX-P1092i has good paper-handling features, particularly when compared with those of Epson's FX printers or even the IBM Proprinter. The built-in tractor-feed is located in the back of the printer, where it is easy to reach and easy to load with paper. If a paper jam occurs, you won't have to spend time digging small pieces of paper out of a reluctant pin-feed mechanism.

The one problem you may have with the Panasonic KX-P1092i is noise. Its unpleasant rasp measures 73 decibels for draft mode and 74 decibels for NLQ mode.

Much worse than the printing noise, however, are the other sounds. The Panasonic KX-P1092i is not timid about telling you off when you do something it doesn't like. Turn the printer on, and the printhead slams against the left side of the printer two or three times. Lift the cover while printing, and you're rewarded with a high-pitched sound. Put the printer off-line while it's receiving data, and it gives off a continous alert that measures only 61 decibels but is so high pitched that you want to don your earmuffs even in July.

Like a printer that communicates with you? Then you may appreciate the Panasonic KX-P1092i's creative expressiveness. On the other hand, if you're the kind of person who customizes new software by first turning off the error beeps, you'll soon tire of the monolog. But considering the printer's good points (clearly outweighing the less-than-good ones), you may be willing to tolerate the literal bells and whistles.

If you buy the Panasonic KX-P1092i, you will probably be listening to it for a long time. Like the venerable Okidata Microline 92, the Panasonic KX-P1092i gives the impression that it will last well into the next century, obediently pounding out text and graphics whenever asked.

—M. David Stone

Panasonic KX-P1524

This year's crop of Panasonic printers includes a 24-pin dot matrix printer that offers respectable speed, good-looking output, and three sets of printer control codes, all for $899: the wide-carriage Panasonic KX-P1524. While best known for its audio and video equipment, Panasonic seems to do everything well, and the Panasonic KX-P1524 continues the company's high level of achievement.

At first glance, you might think the Panasonic KX-P1524 costs about $1,200, largely because of its wide carriage and its sleek, low-profile design. But when you see the printer's speed and graphics quality, you'll find they're more in line with its actual $899 price.

Panasonic claims speeds that run from 67 characters per second in letter quality to 200 cps for high-speed draft. In the PC Labs wide-carriage speed test, the Panasonic KX-P1524 scored 129 cps in high-speed draft, 118 cps in draft, 92 cps in text, and 52 cps in letter quality mode. On the narrow-carriage test it scored slightly lower: 116 cps for high-speed draft, 109 cps for draft mode, and 51 cps for letter quality mode.

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CIRCLE 386 ON READER SERVICE CARD

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Panasonic KX-P1524
Panasonic Industrial Co.
Division of Matsushita Electric Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
(201) 348-7000
List Price: $899
Dimensions (HWD): 6.1 × 24 × 15.4 in.
Weight: 34.8 lbs.
In Short: A wide-carriage, 24-pin dot matrix, this printer earns respectable marks for speed (118 cps in draft), good grades for text and graphics quality, and high scores both for emulating three industry standards and for paper handling.
CIRCLE 636 ON READER SERVICE CARD

Quality of text output varies as much as the speed. Draft shows individual dots—not the sort of output you'll want to read for long stretches. Text mode yields easily readable, correspondence-quality characters. They are suitably dark, with that thin but solid look that characterizes type from 24-pin printheads. Letter quality output is better still. The characters are darker and thicker, with a fully formed look that could almost pass for the work of an electric typewriter.

Each of the modes has a high-speed variant. The speedier versions look much the same as the normal ones, except that the same-sized characters are printed at 12 pitch. Hence the wide characters actually touch their neighbors. Aesthetic appeal loses some points with this shoulder rubbing, but readability stays pretty much the same.

On the PC Labs graphics test, the printer handled both the IBM Proprinter and the Epson LQ-1500 emulations splendidly. Although the bars were not as solidly black as they could be, the Panasonic KX-P1524 printed the patterns in all their detail.

Setting up and using the Panasonic KX-P1524 is problem free. The user manual tells you most of what you need to know, in the order you need to know it. If you're familiar with printers, you should be able to unpack and set up the printer using just the illustrations as a guide. If not, you'll find everything you need in the accompanying text. And—although you probably won't run into any problems—if you have any reason to call Panasonic for information, you'll find the company representatives more knowledgeable than most.

One feature that puts the Panasonic KX-P1524 at the top of its class is its ability to emulate the Epson LQ-1500, the IBM Proprinter, and the Diablo 630. You can change the emulation only by using the DIP switches, which, unfortunately, are located inconveniently on the back panel. You set other default settings through DIP switches, too, but you can change them by using software commands.

The printer earns a solid A+ for paper handling. For one thing, it's remarkably easy to load paper into the built-in tractor-feed. The tractor is hidden under a rear cover that doubles as a paper guide for single sheets. To reach the tractor, you move the guide to its feed position or lift the guide off the printer entirely to get it out of the way.

An even better strategy is at work in the Panasonic KX-P1524's approach to switching between single sheets and fanfold paper. With fanfold paper in place, you hit the printer's memo load button. The printer rolls the fanfold paper back out of the roller and out of way. You can then move the paper-feed lever to friction-feed and print an envelope or a single sheet of paper. When you're done, you simply move the paper-feed lever back to tractor-feed and pull the bail forward to feed the fanfold paper.

The printer fails when it comes to keeping quiet, though. In draft mode it emits an unpleasant 75-decibel rasp. In letter quality mode, the Panasonic KX-P1524 gives off the same rasp in a higher pitch. The promising news is that Panasonic reports that it has remedied the noise problem in current production models.

The Panasonic KX-P1524 earns high marks for its emulations, paper handling, and ease of use. It also scores well in speed, print quality, and graphics for its price category. If your printer budget is under $1,000, the Panasonic KX-P1524 should earn a top rank on your list.
—M. David Stone

Panasonic KX-P1592

Proof of Panasonic Industrial Co.'s manufacturing and marketing acumen is the $649 Panasonic KX-P1592, a 9-pin dot matrix printer. This high-speed, wide-carriage machine matches or tops all the competitors in its class in nearly every important category.

Obviously, a great deal of care and thought went into the Panasonic KX-P1592. Take speed and print quality. In draft mode the printer moved along at 121 characters per second on our tests (Panasonic claims 180 cps). Its draft print quali-

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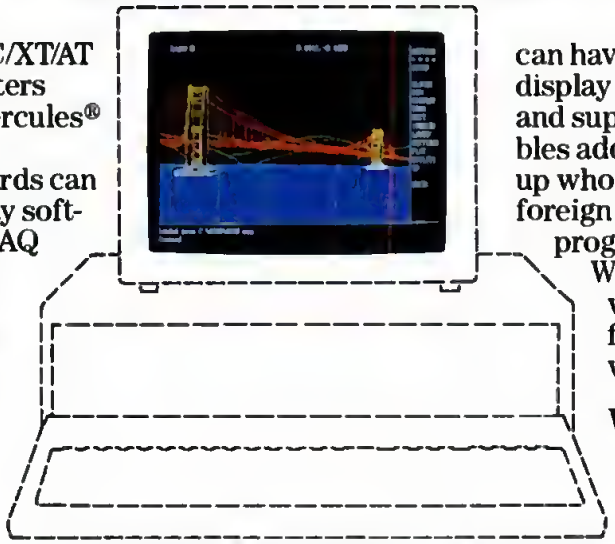


Panasonic KX-P1592
Panasonic Industrial Co.
Division of Matsushita Electric Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) PIC-8086
(201) 348-7000
List Price: $649
Dimensions (HWD): 6.1 × 24 × 15.4 in.
Weight: 30.1 lbs.
In Short: A wide-carriage 9-pin dot matrix, this 121-cps printer delivers high-quality, top-of-the-line performance for a reasonable price.
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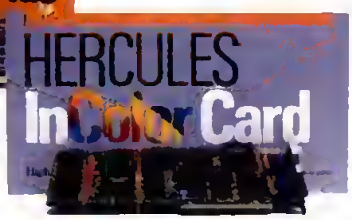
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ty was clean and unburdened by those ugly, faded dots that mar the output of so many dot matrix printers.

In near-letter-quality mode the Panasonic KX-P1592 was equally impressive. Although at 40 cps it makes you wait, the printer's NLQ output is something to write home about—or write a résumé with. The crisp, high-quality NLQ print overrules complaints about dot matrix printers being the wrong medium for business correspondence.

The Panasonic KX-P1592 is adept at producing boldface, underline, compressed, proportional, italic, and superscript and subscript type in three different fonts.

What's more, the Panasonic KX-P1592 is adept at producing boldface, underline, compressed, proportional, italic, and superscript and subscript type in three character fonts: elite, pica, and mikron.

The Panasonic KX-P1592 also shines as a graphics printer, emulating either the Epson FX-100 or the IBM Proprinter. Although its graphics output as an FX-100 imitator appears slightly washed out compared with its output in IBM Proprinter mode, the circles, lines, and patterns are clear and correct in both emulation modes.

Ergonomics is where Panasonic Industrial's manufacturing acumen truly comes into play. The printer weighs only 30 pounds (a middleweight compared to the many printers of this type that tip the scales at 50-plus pounds). Its simple, unobtrusive design blends into an office environment well. And its automatic paper-loading capability operates surprisingly smoothly with both fanfold and single-sheet paper. Finally, the Panasonic KX-P1592's instruction manual is everything a good user guide should be.

The best news? All this printer power and consumer care costs only $649. What's wrong with the Panasonic KX-P1592? Just one thing, as far as I can tell: its 74-decibel sound level makes it a loud worker. What's more, the printer we evaluated emitted a disconcertingly harsh, rubbing noise each time the ribbon slid from one side of the platen to the other. In all, though, we can excuse the Panasonic KX-P1592 for its sound level in light of its overall performance and capabilities.

Backing up all that the printer can do are Panasonic Industrial's excellent technical and product support staff. They quickly and reassuringly answer requests and questions.

In the uncertain world of high technology, the Panasonic KX-P1592 is a savvy investment.—**Jeffrey Rothfeder**

Printronix S-7024

At first glance, the $1,365 Printronix S-7024 9-pin dot matrix printer, with its heavy plastic casing the color of white granite and its sturdy angular design, looks like a powerful, full-performance printer.

Testing the wide-carriage Printronix S-7024 for speed and performance reinforces the initial positive impression it makes. The printer races along at a smooth, high speed: 186 characters per second in high-speed draft mode, 151 cps in normal-speed draft, and 59 cps in correspondence quality. (Printronix claims 240 cps in draft mode.)

For the most part, though, the Printronix S-7024 fails to deliver on its early promise. For the hefty cost of $1,360, you'd expect to get a wide-carriage printer at the top of its class. Instead you find a printer that's missing certain essential capabilities and that makes too many demands on the user before it operates satisfactorily.

Little things that together add up to big annoyances hamper the printer. While it has an excellent correspondence quality that rivals that of the top dot matrix printers, its dull, lifeless draft print resembles at best the output of a low-end dot matrix printer. Further, while it emulates the IBM Proprinter as well as the Anadex 9625 series of printers, the Printronix S-7024 does not yield proportional type in Proprinter emulation. Also missing from the printer's repertoire are subscripts and superscripts.

Loading paper into the Printronix S-7024 is a task that requires far too much patience and persistence. After you insert the paper through the rear or bottom slots in the printer, you must slide it behind a difficult-to-reach plastic ruler that separates the pinch rollers from the platen. About nine times out of ten the paper bunches at the plastic ruler and is irretrievable.

Then there's the Printronix S-7024's manual. It's a disorganized pastiche of incomprehensible switch settings and programming control codes, laid out without corresponding examples, order, or explanation.

Unfortunately, the Printronix S-7024 we evaluated broke a printhead belt on first use and had to be repaired. The technical and service support team at Printronix responded quickly first on the phone and then in person to the problem.

But after the printer had been fixed, it went off-line each time we plugged in a parallel cable leading to a PC. The Printronix technical and support team advised us to cover pin 31 of the parallel interface

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Printronix S-7024
Printronix Corp.
17500 Cartwright Rd.
Irvine, CA 92713
(800) 826-3874
(714) 863-1900
List Price: $1,365; $1,490 with color.
Dimensions (HWD): 7.7 × 27.8 × 16.4 in.
Weight: 40 lbs.
In Short: This quirky wide-carriage, 9-pin dot matrix printer emulates the IBM Proprinter and the Anadex 9625 printers, performs well in graphics and NLQ modes, and produces 182 cps in high-speed draft mode, but it lacks many essential capabilities for its class and price.

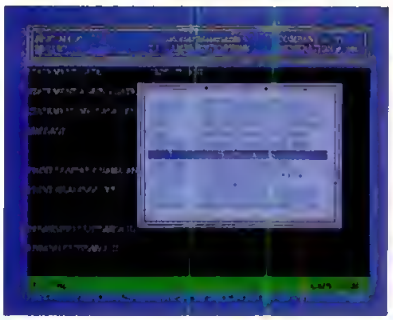
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with Scotch tape to solve the problem. The manual also describes this solution—a fact that suggests that the printer's disturbing failure to operate under these conditions is a frequent occurrence.

It's a shame that the Printronix S-7024 is so eccentric, because it's an able graphics printer. It prints all the characters in the IBM extended graphics set extremely well. And it emulates the IBM Proprinter's graphics capabilities with aplomb, drawing circles, designs, and lines as well as the best printers on the market.

The Printronix S-7024 is full of contradictions. It's a printer that offers all you want in certain ways, such as when printing NLQ type and graphics. Yet it's also a printer that you'd never want in other ways, such as when you have to reload paper or when it goes off-line when you attach a parallel cable. On balance, the quirky Printronix S-7024 has more debits than assets, and a price tag that's too high.
—Jeffrey Rothfeder

Sanyo PR-241

The wide-carriage Sanyo PR-241, from Sanyo Business Systems, is a $999 24-pin dot matrix printer with some good news and some bad news.

First, the good news.

The Sanyo PR-241 is reasonably priced for a potentially high-powered machine that outputs some of the best type that can emerge from a dot matrix printer. In draft mode the printer outputs clear, sharp characters that hardly bear the mark of a dot matrix. In near-letter-quality mode it accomplishes something that few other dot matrix printers are able to do: produce characters that are strong without being strident and splotchy. Moreover, the printer's proportional type is even and tight; no characters look sandwiched and crammed between other characters.

What's more, the PR-241 offers users the luxury of six separate fonts: Courier, Letter Gothic, Prestige Elite, Century, Outline, and OCR-B.

Unfortunately, that's the last of the good news.

On the down side, the Sanyo PR-241 is slow for a printer that costs almost $1,000. In that price range you'd expect about 150 characters per second. But in our speed tests the Sanyo PR-241 printed 111 cps in draft and 54 cps in NLQ. (Sanyo claims a whopping 222 cps in draft and 75 cps in NLQ.)

Emulating the Epson LQ-1500, the Sanyo PR-241 outputs graphics that are, at best, worthy of a low-end dot matrix printer. The circles it produces tend to be ovals, and their circumferences are overinked and scratchy. Plus the patterns and the lines the printer produces are uneven and undistinctive.

While the Sanyo PR-241 has a nonvolatile RAM in which you can store your settings "permanently"—that is, even with the printer turned off—writing to it is far too complicated. Front control-panel buttons double for data entry buttons. When these buttons react sluggishly to your touch, as they did during our evaluations, inputting data becomes a frustrating session of pressing and repressing buttons, wondering if the printer has accepted the requests or simply failed to respond to them.

No tractor-feed comes with the Sanyo PR-241; you must buy one separately from the manufacturer or dealer. And even after you buy the tractor-feed option, you can't expect trouble-free pin-feed printing. The tractor-feed is awkward, and the paper tends to buckle.

To make matters worse, the printer's user manual is rife with grammatical errors, confusing statements, misspellings, and non sequiturs. Control codes appear in confusing order and are described poorly. To locate specific control codes in the manual, you have to flip pages back and forth, and you find that you lose your place again and again.

You won't get much help by calling Sanyo, either. Not only does the company omit its address and phone number from the manual, but when you locate the phone number and dial it, you may not get a response before the phone rings 10 to 15 times. And after you finally do reach technical support, the staff may be like those we spoke to—unfamiliar with the printer's technical details.

The bad news about the Sanyo PR-241 overrides the good news by a wide margin.
—Jeffrey Rothfeder

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Sanyo PR-241
Sanyo Business Systems
51 Joseph St.
Moonachie, NJ 07074
(201) 440-9300
List Price: $999
Dimensions: 4.4 × 22.2 × 12.6 in.
Weight: 19.8 lbs.
In Short: A raft of problems detract from the first-class printing capabilities of this 24-pin, wide-carriage dot matrix printer that produces 111 cps.

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Seikosha MP-5300AI

The Seikosha MP-5300AI, sold by Seikosha America for $799, is a slightly earlier version of the company's recently released $899 SK-3005AI. A 9-pin dot matrix, it has the same basic box for its wide-carriage case as the SK-3005AI has. In fact, the two printers are the same for the most part.

The only difference between the two models is that you cannot control all the print modes from the MP-5300AI's front panel, as you can with the SK-3005AI (also reviewed in this issue). And a color kit is unavailable for the MP-5300AI, while Seikosha sells an optional one for the SK-3005AI.

Otherwise the two units are designed to perform exactly alike. The printer gave us (and Seikosha) a surprise, though: the Seikosha MP-5300AI tested in PC Labs printed about 20 characters per second faster in draft mode than the higher-priced SK-3005AI. Wailing away at 190 cps in draft, the MP-5300AI is eminently suitable for banging out scads of mailing labels, long reports and program runs, or those boring but essential audit trail records. And its 68-

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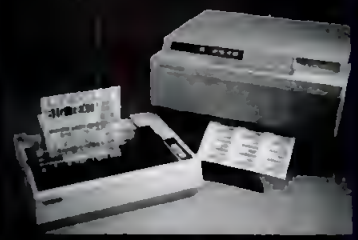
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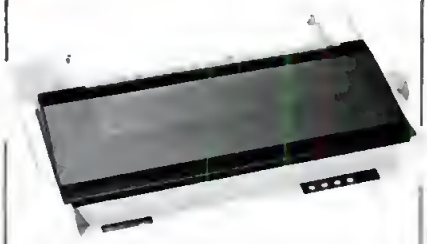
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Seikosha MP-5300AI
Seikosha America Inc.
1111 Macarthur Blvd.
Mahwah, NJ 07430
(201) 529-4655
List Price: $799
Dimensions (HWD): 5.5 × 24 × 18.25 in.
Weight: 17.6 lbs.
In Short: A less-expensive, earlier version of the Seikosha SK-3005AI, this wide-carriage 9-pin dot matrix printer exceeds the speed limits of many of its competitors, flying past them at 190 cps in draft while still producing reasonably good-looking print.
CIRCLE 672 ON READER SERVICE CARD

decibel sound level won't force you to abandon its territory.

In near-letter-quality mode the printer slows to observe a 48-cps speed limit (and a 66-decibel noise zone) and produces print quality that's considered fine for its class. The output is the kind that we would have clamored for in 1983, but today, with the wide availability of high-performance 24-pin dot matrix printers as well as laser printers, it looks unexceptional. In other words, if I used the MP-5300AI's NLQ mode to send my congratulations (or protests) to my Congressional representatives, I'd expect them to read the letter but not frame it for display.

The built-in fonts include the standard 10-pitch pica, 12-pitch elite, and 17- and 20-pitch condensed print, as well as proportional fonts. Both draft and NLQ are available in those sizes, but no other fonts are available as options.

When it comes to emulations, the Seikosha MP-5300AI is a winner. It can act just like an IBM Graphics Printer or Epson FX-80 printer on command.

The MP-5300AI is also easy to set up and reasonably easy to use. You can't enter select mode from the front panel to choose type styles and enhancements, as you can with the Seikosha SK-3000AI and 3005AI. But you can set the left and right margins from the panel, as you can with the 24-pin Seikosha SL-80AI (also reviewed in this issue). The process is quick and easy, and it overrides software settings. Other controls on the front panel include on/off-line, line/form-feed, and NLQ/draft.

Another feature the Seikosha MP-5300AI shares with the 24-pin SL-80AI is its nonlocking tractor-feed. Unfortunately, unless the paper path is clear and the paper source pile lined up just right, keeping the paper straight can be difficult.

The Seikosha MP-5300AI wins the usual accolades for Seikosha documentation, with a helpful table of contents, terrific charts, an informative glossary, and plenty of programming examples to teach even beginners how to use all the printer's features.

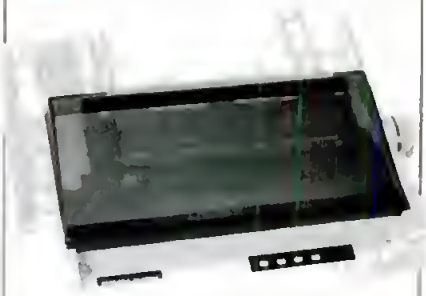
In a market teeming with good 9-pin dot matrix printers, the Seikosha MP-5300AI can take the heat of competition. A speed demon, it also follows all the industry's compatibility standards. So if you need high speed, good 9-pin print quality, and ease of use—on a budget—the fast-track Seikosha MP-5300AI can deliver. It flies through work as if it were aiming to exceed its personal best.—**Bruce Brown**

Seikosha SK-3000AI and SK-3005AI

Seikosha America's SK-3000AI and SK-3005AI are fast, moderately priced ($699 and $899, respectively) workhorses. And they're from good stock. Seikosha makes a whole menagerie of solid dot matrix printers that sell for under $1,000, but these two 9-pin machines show the best breeding: features, print quality, and speed to go the distance. They also accept standard command codes for easy user programming and boast clear, complete manuals.

The only difference between the two units is in the carriage widths. The Seikosha SK-3000AI is the narrow-carriage, 80-

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Seikosha SK-3000AI and SK-3005AI
Seikosha America Inc.
1111 Macarthur Blvd.
Mahwah, NJ 07430
(201) 529-4655
List Price: SK-3000AI, $699; SK-3005AI, $899.
Dimensions (HWD): SK-3000AI, 5.25 × 17 × 16.75 in; SK-3005AI, 5.25 × 24 × 18.5 in.
Weight: SK-3000AI, 18.79 lbs; SK-3005AI, 17.68 lbs.
In Short: The SK-3000AI and SK-3005AI are fast (170 cps in draft) 9-pin dot matrix printers—narrow- and wide-carriage, respectively—capable of handling a lot of work and designed to last.
CIRCLE 671 ON READER SERVICE CARD

column version, selling for $699. Two hundred dollars more buys the wide-carriage version, the SK-3005AI.

The first thing I noticed when I started testing these printers was their speed. They both sprint along at about 172 characters per second in draft mode and 47 cps in near letter quality—terrific speeds for printers priced under $1,000. And the noise level is relatively low: 68 decibels in draft and 66 in NLQ.

You won't fool anyone into thinking you've typed rather than printed the characters that the printers produce, but the NLQ mode is certainly acceptable output for a dot matrix printer. The standard and only available fonts are 10-pitch pica, 12-pitch elite, and two condensed modes (one in 17 pitch and the other a 20-pitch condensed elite). The Seikoshas accept all standard Epson and IBM Proprinter control codes for both text and graphics modes, and they can both produce all the IBM high-order characters.

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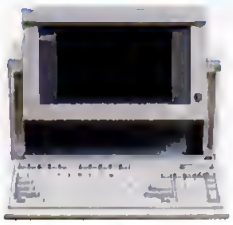


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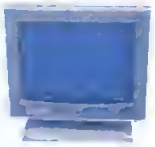
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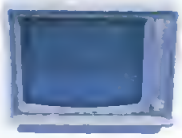
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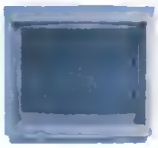
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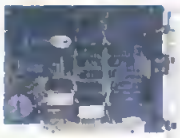
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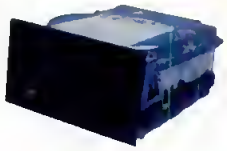
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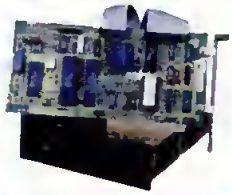
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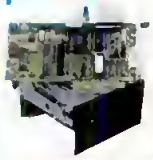
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Setting up the printer is straightforward. One of my favorite features on these machines is the way they tilt the harmonica-style ribbon cartridge. Rather than hold the cartridge horizontally, as most printers do, these Seikoshas keep it at a slant, with the left lower than the right. The whole purpose of this arrangement is to use a greater percentage of the ribbon than is used with horizontal configurations. One minor disappointment is that the paper tractor goes only one way; you have to tug lightly on the page to bring it back .

DIP switches are conveniently located behind a translucent plastic cover in the back of each printer, next to the interface ports. Both serial and parallel ports are standard.

You can choose between print modes quickly and easily from the front panel. Holding the On-line/Select switch for more than 1 second puts the printer in mode select. By using the form- and line-feed buttons, you line up the printhead with the desired print mode. The choices available are pica, elite, condensed (17 pitch), condensed elite (20 pitch), proportional, italic (10 pitch), and bold (10 pitch). Modes chosen this way override software commands.

This feature and the printer's speed are the hottest features of the SK-3000AI and SK-3005AI. Together they present a good buying argument. Also, a color option is available for both printers and offers Epson JX-80 color printing compatibility.

Both printers also use Seikosha's two-level printhead protection. When operating temperatures reach a specified level, the head stops printing in both directions and works unidirectionally only. If the temperature reaches the second level, the head stops and printing pauses until the printhead temperature decreases to a safe level. A feature like this could add years to printer life.

Seikosha's documentation gives full printer specifications and terrific information about programming command codes, including sample programs. The manual also includes a spiderweblike graphic to show which commands work with each other and how to switch from one mode to another. At first the drawing seems confusing, but it's actually helpful.

The Seikosha SL-3000AI and SK-3005AI are solid, speedy, easy-to-use workhorses that can give you a good return on your dollar. Second-time printer buyers who want to move up to a higher-performance machine will want to consider putting their money on these potential front-runners.—**Bruce Brown**

Seikosha SL-80AI

The Seikosha SL-80AI—Seikosha America's aggressively priced ($549) 24-pin narrow-carriage dot matrix printer—is designed for the person who needs excellent print as well as graphics. The trade-off is speed.

The SL-80AI produces beautiful type, but you have to wait for it. The NLQ mode, for which most will buy this machine, drags along at 31 characters per second, which is not much faster than the low-end letter-quality machines. Draft mode, which is decidedly that, is about twice as fast (60 cps), with a speed and print quality reminiscent of those of dot matrix printers manufactured in the early 1980s.

The default type style of the Seikosha SL-80AI is its near-letter-quality mode. The printer's fonts are plain rather than fancy. You can select 10-pitch pica, 12-pitch elite and condensed, and condensed elite fonts at 17 and 20 characters per inch. Seikosha does not sell any optional fonts.

Besides choosing from the four type sizes, you can set controls for boldface and double-strike characters, italic, underlining, superscript and subscript, and proportional spacing. The printer will print all the IBM high-order characters, and it can emulate both the IBM Graphics Printer and the Epson LQ-1500 in both character and graphics printing.

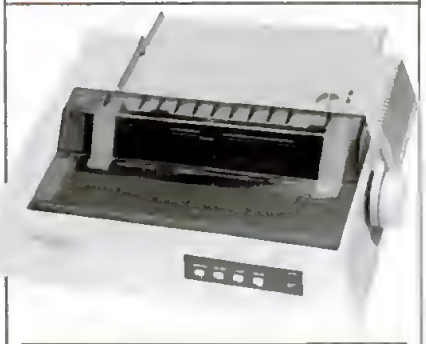
The Seikosha SL-80AI is quietly unobtrusive as it lopes along, registering just 66 decibels in draft and 67 decibels in NLQ. Its small size and low noise level make it ideal for apartment and dorm use.

The printer's front control panel includes switches for on/off-line, line- and form-feeds, margin setting, and "H. Mode," which Seikosha brashly describes as high-speed mode. Even with H. Mode in effect, the printer is in no way a sprinter.

The typewriter has made us appreciate the convenience of being able to set margins easily, and Seikosha has adopted that feature for the SL-80AI's front-panel controls. To enter margin-setting mode, you first hold the on-line button for more than one second. The on-line indicator then starts to blink, indicating the margin mode. Pressing the form-feed button moves the printhead to the right, one space at a time, so that you can position the left margin. To do the same for the right margin, you use the line-feed button. Once you've positioned both margins to your satisfaction, pressing the H. Mode button registers the settings as the new margins.

The Seikosha SL-80AI also features printhead protection and automatic paper loading. If the printhead becomes overheated, the printer will slow down to prevent damage. An external paper tractor is integral to the printer, but since it has no tractor locks, you must be more careful than usual about placing the box or pile of source paper in the right spot. If the paper source is off to one side, the paper in the printer is likely to creep to that side while the machine makes a lengthy print run.

PC MAGAZINE FACT FILE



Seikosha SL-80AI
Seikosha America Inc.
1111 Macarthur Blvd.
Mahwah, NJ 07430
(201) 529-4655
List Price: $549
Dimensions (HWD): 5.25 × 16.5 × 14.5 in.
Weight: 16.13 lbs.
In Short: One of the least costly 24-pin narrow-carriage dot matrix printers on the market, this machine is fairly slow (60 cps in draft), but its price and print quality make it a good choice for writers, students, and professionals.

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ARCHITECTURE If the micro world were not so vened, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of epplications. QNX owes its success (over 30,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovetive than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 16 terminals and modems to connect to any computer.

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PC's, AT's and PS/2's OS/2 and UNIX severely restnct hardware that can be used: you must replece all your PC's with AT's. In contrast, QNX runs superbly on PC's and literally soars on AT's and PS/2's. You can run your unmodified QNX applications on any mix of machines, either standalone or in a QNX local area network, in real mode on PC's or in protected mode on AT's. Only QNX lets you run multi-user/multi-tasking with networking on ell classes of machines.

REAL TIME QNX real-time performance leaves both OS/2 and UNIX wallowing at the gate. In fact, QNX is in use at thousands of real-time sites, right now.

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Since the Seikosha SL-80AI is bound to appeal to a lot of first-time printer buyers, it's important that the user manual maintain Seikosha's high standards for documentation, and it does. The manual is complete, clear, and concise. One entire section is devoted to showing beginners how to program the printer to use special features such as character modes, margin settings, page length and tab settings, and graphic printing. In each case, a full program listing the BASIC language code used to invoke a feature or make a setting is included.

The Seikosha SL-80AI is quietly unobtrusive as it lopes along, registering just 66 decibels in draft and 67 decibels in NLQ.

Granted, many will never use this programming information, since most word processing programs control the settings and features. But its thoughtful inclusion will assist those who do need it, and it may even remove some of the mystery of the printer's operation for novices. A reference section for all printer command codes is another convenient part of the documentation.

But one of the most impressive features of the manual is the many clear charts that depict the printer's features and their relative hierarchy and use. Also, helpful quick-reference charts abound. The only thing the manual lacks is an index, but the table of contents is so clear and complete that you'll seldom miss having one.

If you're a professional, a writer, or a student who uses a PC primarily for correspondence or for processing and managing documents that include text and graphics, the Seikosha SL-80AI may be your best bet. It's slow, but the good-looking output outshines that of the usual 9-pin printers you've been able to afford. You also get several convenient features as well as a great manual. For a 24-pin dot matrix printer, the Seikosha SL-80AI is priced aggressively low. It may become a new standard for use in any situation—in the office, at home, or in the dorm—that requires low-volume printing.—**Bruce Brown**

Seikosha SP-180AI

You'll find few printers on the market cheaper than Seikosha America's $249 SP-180AI, a no-frills, narrow-carriage, 9-pin dot matrix printer made specifically for the economy minded. Unfortunately, Seikosha apparently cut so many corners to design and manufacture the SP-180AI that the printer's limitations overshadow the benefit of the price break.

The SP-180AI's front control panel, for example, is positively barren. It has an on/off-line switch, but there is nothing else other than a light that indicates whether the SP-180AI is in near-letter-quality or draft mode. In order to move into NLQ mode, you have to press the on/off-line switch once and put the printer off-line. Then you must press the on/off-line button once again for more than 2 seconds, and voilà, you're in NLQ mode.

Wouldn't adding an NLQ/draft button have been better? And where has a line/form-feed button vanished to? You'd be hard-pressed to find another modern printer without this essential button.

In terms of print quality, the SP-180AI fares little better. Its NLQ characters are acceptable, though somewhat light and uneven. Would that the same could be said of its draft characters! The almost-unusable draft characters are extremely light and unattractively dotted.

One area in which the SP-180AI does shine, however, is in printing proportional type. The spacing is good, and few letters shove up against those preceding them.

Fast print speed would compensate somewhat for the poor quality of the NLQ and draft output, but the SP-180AI's speed ratings are nearly as inferior as the print. In our benchmark tests the printer rated 51 characters per second in draft (which is a far cry from Seikosha's rating of 100 cps) and only 16 cps in NLQ.

The SP-180AI emulates the Epson FX-100 and the IBM Graphics Printer. Ironically, while its text printing leaves much to be desired, its graphics output is far more palatable. The printer forms circles extremely well and builds intricate patterns that exhibit a clarity that many other, far more expensive dot matrix printers cannot produce. Its block lines, though, do not end firmly but tend to trail off.

One definite plus for the SP-180AI is the clear, thorough instruction manual, on which Seikosha obviously did not skimp. But a serious omission is Seikosha's telephone number or even its U.S. address—information that users not only require but deserve when they buy a printer.

Many design and manufacturing economies serve to cut the cost of the Seikosha SP-180AI, but the cost to the user is print quality, front-panel control, and speed. Unfortunately for Seikosha, other manufacturers of printers in the same price category, notably the competitive Panasonic Industrial, have been able to produce low-cost printers without slashing the features and performance levels so drastically.
—**Jeffrey Rothfeder**

PC MAGAZINE FACT FILE



Seikosha SP-180AI
Seikosha America Inc
1111 Macarthur Blvd.
Mahwah, NJ 07430
(201) 529-4655
List Price: $249
Dimensions (HWD): 4.61 × 16 × 11.8 in.
Weight: 9.2 lbs.
In Short: A $249 no-frills 9-pin dot matrix printer, this narrow-carriage machine prints inferior draft type at 51 cps; graphics output is unexpectedly good, though, in both Epson FX-100 and IBM Graphics Printer emulations.

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Seikosha SP-1200AI

The Seikosha SP-1200AI, a $319 9-pin dot matrix printer, excels at graphics, an area in which few lower-cost dot matrix printers perform particularly well. Emulating the Epson FX-100 and the IBM Graphics Printer, the narrow-carriage SP-1200AI produces circles that are well rounded and well contoured, with smooth circumferences. Moreover, the intricate patterns it creates are clean and sharp.

In terms of graphics output, my only complaint is that the block lines trail off. Their right-side vertical edges tend to be concave instead of straight.

Beyond its graphics capabilities, though, the SP-1200AI is a printer with problems. To start with, its $319 price makes it costlier than today's typical low-end printers, which cost between $250 and $300. But it doesn't offer much for the extra dollars.

Yes, the SP-1200AI has an excellent automatic paper-loading system for cut-sheet pages. Yes, it has a handy set of soft switches in its front panel for choosing the typical printer functions. But beyond that, the SP-1200AI simply doesn't seem to be able to justify its higher price.

Take its text-printing output, for instance. Its near-letter-quality characters are merely acceptable: they look a bit scattershot and not dense enough. Draft characters are even worse. In draft mode the output of the SP-1200AI is so faded that it will send you to the optician. Yet the dots that make up the draft characters look so magnified that you think you're wearing the wrong prescription glasses. (I commend the proportional type, though; the spacing is so even that each letter seems to hold its own slot without being sandwiched in the line.)

The SP-1200AI is far too slow a printer for $319. At that price, if not at $30 to $40 less, you'd expect over 100 characters per second. But in our speed tests the SP-1200AI printed 76 cps in draft and 19 cps in NLQ. (Seikosha claims 120 cps and 25 cps in draft and NLQ, respectively.)

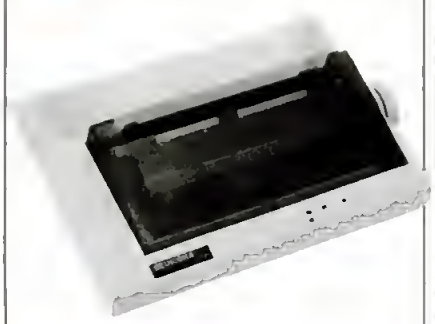
The SP-1200AI boasts one of the best user manuals in the low-end dot matrix printer marketplace. The 150-page documentation is an exhaustive excursion into dot matrix printing in general and the SP-1200AI in particular. The best part is an ambitious 20-page section entitled "Introduction to Printer Features for Beginners."

Unfortunately, Seikosha fails to tell users how to get in touch with the company. Its telephone number and address are nowhere to be found. When you buy a printer, you at least deserve to have a way of reaching the manufacturer.

If the SP-1200AI cost $60 less, I'd still have a hard time recommending it because of its poor text output. At its present price, I cannot recommend it at all.

—Jeffrey Rothfeder

PC MAGAZINE FACT FILE



Seikosha SP-1200AI
Seikosha America Inc.
1111 Macarthur Blvd.
Mahwah, NJ 07430
(201) 529-4655
List Price: $319
Dimensions (HWD): 4.65 × 16.4 × 11.5 in.
Weight: 11.2 lbs.
In Short: Emulating the Epson FX-100 and the IBM Graphics Printer, this 9-pin narrow-carriage dot matrix printer produces graphics that rival those of the best of its competitors, but the quality of its 76-cps text output leaves much to be desired.

CIRCLE 631 ON READER SERVICE CARD

Star NB24-15

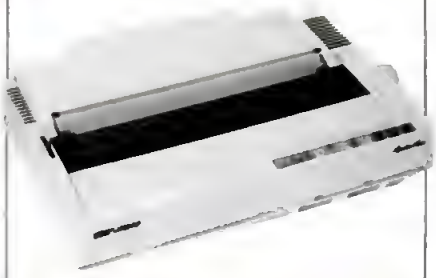
The $999 Star NB24-15 is an excellent, if slightly quirky, 24-pin wide-carriage dot matrix printer. One of Star Micronics America's top-of-the-line machines, it produces top-notch letter quality and draft type, is compatible with both the Epson LQ-1000 and the IBM Proprinter, has a front panel that enables users to choose the typeface and enhancements quickly, and, all in all, contains a great deal to recommend it.

There's nothing wrong with the printer's design. The Star NB24-15's touch-sensitive switches give you access to a variety of options, including print enhancements, draft or letter quality modes, and pitch (pica, proportional, elite, condensed, or a combination thereof), as well as the usual top-of-form, paper-feed, and on-line functions.

By pressing keys in combinations, you can also set margins, micro-feed paper, or put the printer into Panel Lock mode, which protects any of the features from being overridden by control codes. The only nonmembrane switch on the NB24-15 is a dial that adjusts form lengths from 3.5 inches to 14 inches.

The 125-character-per-second NB24-15 has four paper-feed positions: one for adjusting paper, a second for pin-feed paper, a third for friction-feed, and a fourth for auto-feed. Paper is very easy to load.

PC MAGAZINE FACT FILE



Star NB24-15
Star Micronics America Inc.
200 Park Ave., #3510
New York, NY 10166
(800) 53S-TARO (technical assistance)
(212) 986-6770
List Price: $999
Dimensions (HWD): 16.25 × 22.5 × 4.75 in
Weight: 32.6 lbs
In Short: Despite a few minor quirks, the 125-cps Star NB24-15 is a well-planned, flexible, wide-carriage 24-pin dot matrix printer with excellent print quality.

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Simply fit the forms into the pin-feeds and adjust the lever to auto-feed. For single sheets, a paper guide that usually fits flush on the back of the printer conveniently raises to become a sheet-feeder.

Despite the presence of all these advanced features, the folks who designed the Star NB24-15 are of the old school and don't trust you to keep your fingers away from the printhead while the machine operates. Therefore, the printer does not work while the cover is off.

The pressure-sensitive switches have an intrusive accompanying tone—loud enough to become bothersome in an office where two or more of the machines may exist. It also appears that the Star NB24-15's designers believe the best kind of DIP switch is an unseen DIP switch. Not only are DIP switches located below the printhead, but they sit below the ribbon cartridge as well, making it impossible to change the settings without the somewhat messy procedure of removing the ribbon.

The printer comes with a default of letter quality pica. Strangely enough, there's no way to reset the printer to a draft default. You can switch among Epson LQ-1000, IBM Proprinter, and IBM Graphics Printer emulations. But although the printer passed the PC Labs Epson graphics emulation test it had a problem with the Proprinter emulation test. The machine printed the first four rows of the circular image several columns over to the left, giving the impression that the top of the graphic had been sheared off. This may not affect the printer's performance in most cases, but users who want to use its IBM Proprinter emulation should check it out carefully first.

Print quality is excellent. The letter quality output comes as close as you can get to typewriter emulation with a dot matrix printer; the letters are smooth, well-defined, and uniform. The draft type, although not suitable for business correspondence, is very readable. The printer is reasonably fast; the draft mode trotted along at a respectable 125 cps, while the NLQ mode came in at 53 cps.

For its high-quality output alone, I would wholeheartedly recommend the Star NR24-15. Despite some quirks that might put off some users, it's still a lot of printer for $999.—**Barbara Krasnoff**

Star NR-15

Moderation in all things summarizes the wide-carriage, 9-pin Star NR-15. It's moderately priced and reasonably good, offers a fair number of convenient features, and is appropriate for moderately large offices.

Like other Star Micronics America printers, the $799 NR-15 is lightweight and low-slung. Its three covers work much more efficiently than do many of those I've seen on similar printers. They consist of a printer cover, which guards the printhead and ribbon; a mute cover, which attaches to the printer cover and has a slot that guides the paper out of the printer; and a paper guide, which keeps outgoing paper separate from incoming. There are four platen settings: open, fanfold, single-sheet, and auto-feed. The latter works especially well, bringing the paper forward to the top of sheet quite efficiently.

The control panel is composed of membrane switches that handle on/off-line, paper-feed, top-of-form, print pitch, and draft or near-letter-quality mode. The membranes beep whenever you use them, which can become annoying over time. The only nonmembrane switch is a small dial that sets form lengths from 3.5 inches to 14 inches.

Star Micronics has labeled its print pitch switch Prop, 136, 163, and 233; although these designations correspond to proportional, pica, elite, and condensed, they are unnecessarily obscure.

One of the Star NR-15's more impressive features is its Panel Lock mode, which allows you to override any incoming control codes. You activate the Panel Lock mode by holding down the mode switch while turning on the printer. Thus, your printer will remain in either draft or near-letter-quality mode despite the fact that control codes are being sent to it from software. In addition, you can adjust forward and reverse micro-feed, top-of-form settings, and right and left margin settings by pressing the switches on the control panel.

The factory defaults for the Star NR-15 are draft and pica; you can change them to condensed and NLQ by adjusting the DIP switches. Like other printer manufacturers, Star Micronics has placed the DIP switches in a less-than-convenient spot: under a plastic cover beneath the printer ribbon, which forces you to remove the ribbon if you need to change the defaults.

The printer's factory setting, an Epson FX emulation, can be switched to either IBM Proprinter or IBM PC Graphics Printer mode. But although the printer passed the PC Labs Epson graphics emulation test with flying colors, a problem arose with the IBM Proprinter emulation. The NR-15 reproduced the test graphic under IBM Proprinter emulation, but its printhead tried to move past the rightmost edge of the platen. According to a Star Micronics representative, users have never experienced similar IBM Proprinter compatibility problems. Although the NR-15's response to our test does not mean that the printer is not IBM Proprinter compatible, I would recommend that those planning to use the Proprinter mode test the printer with their software first.

The Star NR-15 offers very good print quality for a 9-pin printer. NLQ type is dark and clean, and only the closest scruti-

PC MAGAZINE FACT FILE



Star NR-15
Star Micronics America Inc.
200 Park Ave., #3510
New York, NY 10166
(800) 53S-TAR0 (technical assistance)
(212) 986-6770
List Price: $799
Dimensions (HWD): 14.1 × 21.3 × 4.1 in.
Weight: 26.2 lbs.
In Short: The 151-cps Star NR-15 is a well-designed and efficient wide-carriage 9-pin machine that provides reasonably good output at a moderate price.

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ny reveals slight jagged edges. Draft quality type is perfectly fine for draft manuscripts.

All printing enhancements, including super- and subscripts, italic, and underlining, are available in both draft and NLQ modes; this, plus the availability of proportional spacing in both draft and NLQ, makes the NR-15 a flexible machine. However, with a measured noise level of 81 decibels in draft mode and 78 in NLQ, the printer isn't exactly quiet. And although we timed the NR-15 at 151 cps in draft mode, it slowed down to less than a third of that—at 42 cps—in NLQ mode.

At a moderately expensive price of $799, the Star NR-15 is not a bad choice for your office—if all you want is a moderately good machine.—**Barbara Krasnoff**

Star NX-15

Star Micronics America produces ten dot matrix printers for IBM and IBM-compatible computers. Of those, the Star NX-15 is the vendor's simplest printer, as well as its least expensive wide-carriage machine. In its simplicity, though, the $499 NX-15 avoids some of the quirks that afflict its more elaborate brethren.

At first glance, the NX-15 closely resembles another 9-pin Star printer, the $799 NR-15. Both are sleek printers equipped with touch-sensitive membrane switches that are located on their front right-hand panels. These include a mode switch that toggles between draft and NLQ print; a print-pitch switch that allows you to choose between pica, elite, compressed, and proportional type; plus top-of-form (TOF), paper-feed, and on-line buttons. The switches can also be used in combination to set margins, do forward or reverse micro-feeds, and set the TOF. (For some reason, the button that is labeled TOF switches the printer into italic mode when it's pressed by itself—a handy, if mislabeled, feature.)

I was pleased to see that even in this less-expensive model, Star Micronics included its helpful Panel Lock feature. By holding down either the mode or print pitch keys while turning on the machine, you can lock that function, thus protecting it from unwanted software controls. The printer also has a well-designed self-load system that brings the paper around the platen and into position with little fuss.

FACT FILE



Star NX-15
Star Micronics America Inc.
200 Park Ave., #3510
New York, NY 10166
(800) 53S-TAR0 (technical assistance)
(212) 986-6770
List Price: $499
Dimensions (HWD): 13 × 2t × 4 in.
Weight: 23.6 lbs
In Short: A wide-carriage 9-pin dot matrix machine with several nice features, including a self-loading mechanism and panel locking, the NX-15 is hampered by its slow speed—84 cps in draft mode and 22 cps in NLQ.

CIRCLE 452 ON READER SERVICE CARD

As usual for Star printers, the NX-15's DIP switches are located where it's most difficult to get at them—beneath the ribbon cartridge. However, Star Micronics has simplified the process of converting from a parallel to a serial interface by offering an accessible slot for the interface board.

Although the NX-15 has a front printhead cover and paper guide, it lacks the separate sound cover that other models in the line have. That didn't seem to affect the printer's loudness, however; in fact, on the PC Labs sound level test, the volume was measured at 79 decibels in draft mode—2 decibels quieter than the more expensive NR-15.

But the lack of a cover isn't all that makes the Star NX-15 less costly. In both the NLQ and draft modes, the printer is at least twice as slow as the NR-15. In fact, at 22 cps, the NLQ mode was one of the slowest I tested this year and would probably try the patience of many business users. However, NLQ output is close to perfect, despite some unevenness of tone and the tendency of the "p" to float a little above the line. The draft mode, clocked at 84 cps, produces readable output but is not adequate for business correspondence. The printer also produced good quality graphics in both its Epson and IBM emulations.

Besides its manual, which is well planned and easy to read, the Star NX-15 comes with a handy plastic-coated color card that lays out the major points of how to operate the printer. Those include how to use the control panel, install the interface board and ribbon cartridge, and load paper.

Altogether, the Star NX-15 is a good, all-around dot matrix printer that rates top marks for the ease of use and accessibility of its features. Had Star Micronics chosen a slightly more even typeface and not slowed up the printer as much, it would have been even better.
—Barbara Krasnoff

Tektronix 4696

With the precision of a pointillist, the narrow-carriage Tektronix 4696 ink jet printer systematically sprays the white ground of paper with dots of color, creating 120 dots-per-inch graphics that will impress even the most critical viewers. Not only that, but the $1,795 machine stands out among graphics printers with its ability to print decent quality text as well.

Setting up the Tektronix 4696 is a no-mess operation, requiring only that you install four cartridges; it didn't warrant my donning a lab coat in preparation for the task. Cartridges come in red, yellow, blue, or black and cost $9 for a box of two. All the instructions and illustrations you need to set up the printer are in a supplementary section in the back of the user manual. Tektronix also supplies a plastic quick-reference sheet that looks like a safety and emergency exit guide you'd find in an airplane—not the most aesthetically appealing chart, especially for a company that devotes a chapter of its user manual to the art of using colors effectively.

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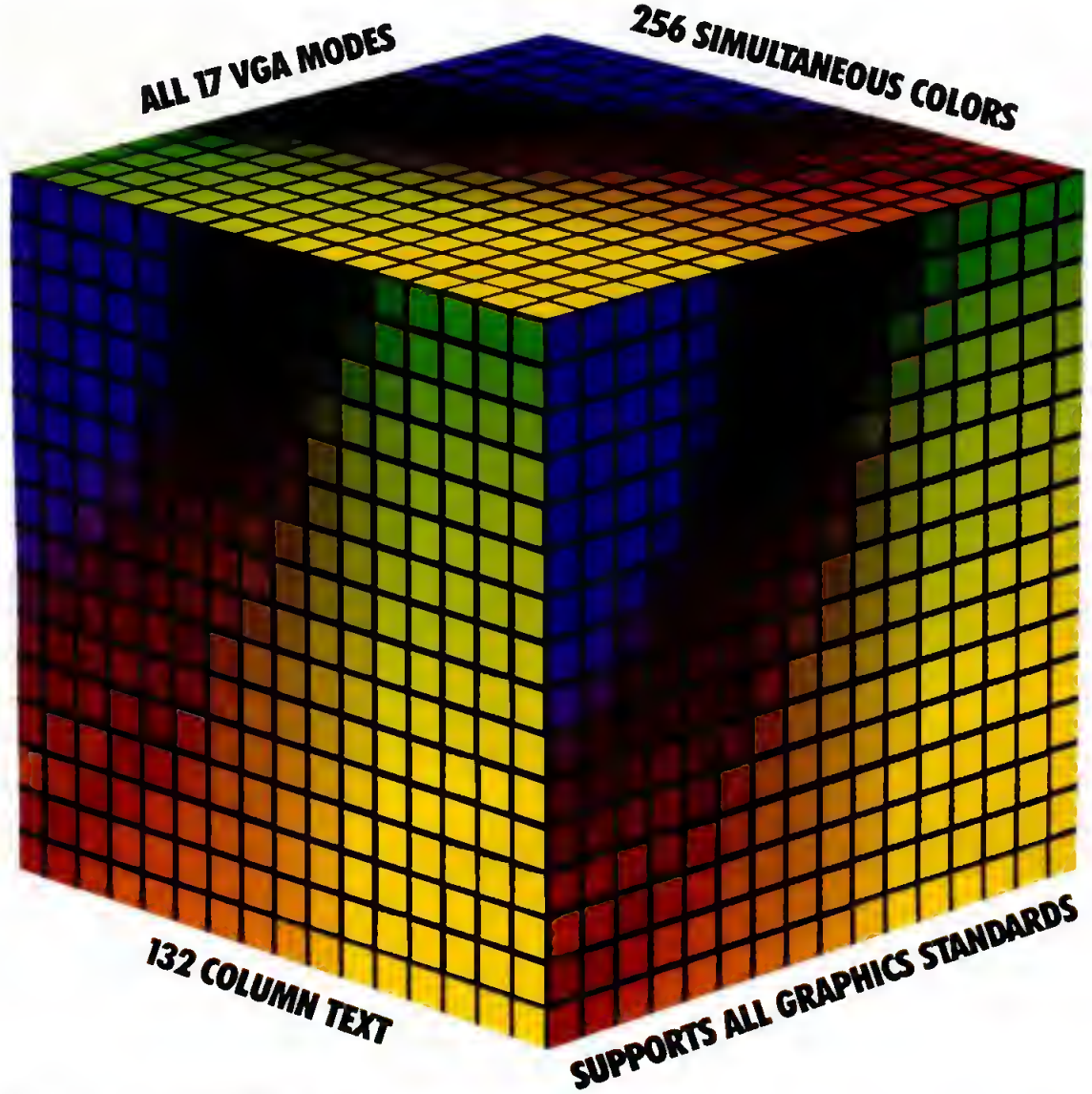
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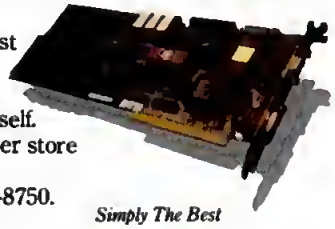
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CIRCLE 517 ON READER SERVICE CARD

PC MAGAZINE FACT FILE



Tektronix 4696
Tektronix Inc.
P.O. Box 500
Beaverton, OR 97077
(800) 225-5434
(503) 627-7111
List Price: $1,795
Dimensions (HWD): 6 × 19.9 × 13.5 in.
Weight: 29 lbs.
In Short: Requiring clay-coated paper for best results, this 26 cps narrow-carriage color ink jet printer stands out for its ability to print good-looking draft-quality text; however, it is not compatible with any other printers and lacks basic character enhancements except for underlining.

CIRCLE 462 ON READER SERVICE CARD

output on clay-coated paper, which is available in rolls for $35. A spool that you mount on the back of the printer holds the roll of paper in place, and the printer had no trouble keeping the paper aligned.

The front panel has four indicator lights that blink when their respective ink cartridges are empty. The panel also has a select switch that acts as an on/off-line button, a media switch that allows you to select between paper and transparencies, and a line-feed switch that feeds paper continuously until pressure is removed.

The Tektronix 4696 has a number of features that help to keep it in working order. To prevent air bubbles and blockages from stopping the flow of ink, you can activate the printhead recovery cycle, a three-step process that closes off the ink supply to the printhead, purges it of air bubbles, and then reopens the ink supply and purges the ink jets again. The process takes approximately 5 minutes.

To prevent the printhead from drying up, the printer enters an automatic printhead protection cycle. During this cycle, which occurs every 4 minutes while the machine is not printing, a small stream of ink is ejected but does not, of course, land on the paper. When the printer is turned off, it enters a power-down cycle that washes the printhead with maintenance fluid and caps the heads.

The Tektronix 4696 can be driven by many popular applications programs, including *Harvard Graphics*, *PCPaintbrush*, *AutoCAD*, *MicroCAD*, *Zenographics*, *Autumn*, *Mirage*, and *ChartMaster*. Some of these programs allow you to print graphics from *1-2-3* and *dBASE*. *Pizazz* software is included when you purchase the printer. This utility is RAM resident, and when you want to make a screen copy (during practically any application), you just have to call it up.

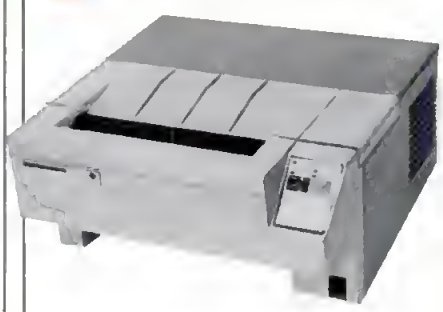
The Tektronix 4696 has three modes, each one a little slower and a little clearer than the next. The modes can be selected off-line from the front panel. Mode 1, or draft mode, prints 26 characters per second. Mode 2 prints an enhanced black print, but the other colors remain as in mode 1. Mode 3 enhances all colors. In this mode, which prints an acceptable NLQ print, we timed the printer at 14 cps. If you run out of ink in the middle of printing, all you have to do is fill the cartridge with ink and resume printing.

Although the Tektronix 4696 can print alphanumeric characters, it lacks basic character enhancements except for underlining and is not compatible with any other printers. But if you want to produce high-quality presentation graphics as well as having a machine that can print out a text on art criticism, you should consider the Tektronix 4696.—**Erika Hortz**

Texas Instruments 885 Demand Document Printer

Businesses that need a printer primarily to handle preprinted forms are the main target market for the Texas Instruments 885 Demand Document Printer, priced at $2,295. The TI 885 is a 9-pin dot matrix machine designed to print checks, invoices, labels,

PC MAGAZINE FACT FILE



Texas Instruments 885 Demand Document Printer
Texas Instruments Inc
P.O. Box 809063
Dallas, TX 75380-9063
(800) 527-3500
List Price: $2,295
Dimensions (HWD): 9 × 17.7 × 17.7 in.
Weight: 50 lbs.
In Short: This narrow-carriage 9-pin dot matrix printer is adept at handling forms, either single or multiple-part, printing at 195 cps; best used for customized applications like printing airline tickets.

CIRCLE 648 ON READER SERVICE CARD

tickets, and lists. It can handle forms 3.5 to 9.5 inches wide, at a combined paper weight of up to 100 pounds.

One of the requirements for a forms printer is the ability to churn out large quantities of work quickly. The TI 885 responds with a tested speed of 195 characters per second in draft mode. We also tried it in enhanced mode—comparable to boldface on most printers—in which it produced 60 cps.

While the vendor bills the TI 885 as a correspondence printer as well as a forms printer, the TI 885 is appropriate for correspondence use only in highly customized applications. Generally, printers of this sort are designed to be attached to minicomputers or mainframes, but the TI 885 connects directly to a PC.

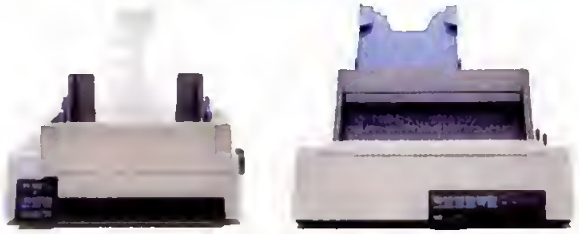
The TI 885's print looks familiar; it's what you see on many computer-generated invoices, tickets, and slips. One thing the TI 885 doesn't claim to be is a letter quality printer. The enhanced print mode is simply heavy draft quality. But when we tried the

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The popular IBM Proprinter II (left) and the IBM Proprinter XL24, ideal for printing on wide paper (right).



The IBM Proprinter X24 with optional sheet feed (left) and the IBM Quietwriter III Printer with single-drawer sheet feed (right).

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your public image.



CIRCLE 519 ON READER SERVICE CARD

TI 885 with five-part forms including carbons, it produced legible type on all copies—the key to the success of a printer like this one.

You've probably heard printers that sound like the TI 855 printing on counters in banks and retail stores. The machine is fairly noisy: 81 decibels in draft mode and 78 decibels in enhanced mode.

The $2,295 Texas Instruments 885 is a 9-pin dot matrix machine designed to print checks, invoices, labels, tickets, and lists. It can handle forms 3.5 to 9.5 inches wide, at a combined paper weight of up to 100 pounds.

Installing the printer—which comes with both serial and parallel ports—is easy. The printer case is compact, designed to require only a small amount of counter space. Paper loads from the front, making it easy to switch forms. Since the tractor is vertically mounted on the bottom front, you don't even have to open the case to load paper. And the upright printing position produces zero tear off, minimizing paper waste.

You can select many of the printer settings through a menu controlled from the top-panel buttons, as well as through software commands. The menu system prints options on paper, although they are almost impossible to see because the current setting doesn't show above the printer's dark top cover.

The TI 885 uses ANSI standard command codes, but you cannot use standard printer control commands to generate italic, superscripts or subscripts, proportional spacing, or other fonts. Texas Instruments emphasizes that in most cases customers use the printer in customized applications, in which responding to standard control commands is not required.

The printer doesn't even pretend to emulate other, more popular PC printers. It didn't pass any of our graphics compatibility tests, nor could it print the IBM high-order character set. The vendor occasionally produces custom versions of the printer firmware for large customers such as airlines, but the price of printer customization is prohibitive for buyers of only a single machine or even of small quantities. More commonly, buyers customize the printer by using applications software. Fortunately, the TI 885's thorough user manual includes complete specifications and numerous charts.

The TI 885 is a specialist with one true calling: printing multiple-copy forms on a heavy-duty cycle at high speeds.

—Bruce Brown

Toshiba P351C

The Toshiba P351C, Toshiba America's $1,599 wide-carriage 24-pin dot matrix printer, is a serious machine. Large and rugged, it's clearly intended for busy office and professional use.

You get two letter-quality fonts with the printer (Courier 10 and Prestige Elite 12), and additional fonts are available from cartridges or software. You can also use the Toshiba P351C with a four-color ribbon for graphics printing.

The Toshiba P351C is compatible with the IBM PC Graphics Printer and the Qume Sprint 11 in text and graphics modes, and with the IBM Color Printer in color. The printer's color separation looked very good, and the colors were bright.

In both near-letter-quality and draft modes, the Toshiba P351C is commendably fast. Draft output rated 163 characters per second on the PC Labs tests, while NLQ output rated 49 cps. Both speeds are consistent with those of other printers of the same type and price range.

The Toshiba P351C's NLQ print looks crisp in its standard Courier 10 and Prestige Elite 12 fonts. Unfortunately, printers in this price range can't avoid comparison with type produced by low-cost laser printers, and a dot matrix printer like the Toshiba P351C can't compete with laser printers for print quality. Yet the additional features and capabilities that the Toshiba P351C and other high-end dot matrix printers offer make them workhorse printers for situations that require high speed and can make do with draft print.

If you need additional fonts, you can get them from Toshiba, either in the form of cartridges (which contain two fonts each for $79 per cartridge) or on disk (for $35) for downloading into the printer's 4K memory.

Because the Toshiba P351C is a big unit with large parts that move quickly, it makes a fair amount of noise. It measures 72 decibels in draft mode and 73 decibels in NLQ mode. These sound levels are not unusual, but the busy office for which this printer is intended will want to isolate the printer in an enclosed area.

Installing the printer is easy. It has both parallel and serial connectors. The only tricky part is deciding how you want the Toshiba P351C configured. Once you have made that determination, the manual

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Toshiba P351C
Toshiba America Inc.
Information Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 730-4774
List Price: $1,599; $219 for bidirectional tractor-feed and $349 for dual-bin sheet-feeder.
Dimensions (HWD): 10 × 23.5 × 15 in.
Weight: 33 lbs.
In Short: This heavy-duty, wide-carriage, 24-pin dot matrix printer is designed for offices that need near-letter-quality type, fast draft printing (163 cps), plus single- and multiple-color graphics printing.

CIRCLE 661 ON READER SERVICE CARD



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EDITOR'S CHOICE

- **C. Itoh C-715A**
- **Epson LQ-850/LQ-1050**
- **Panasonic KX-P1091i**

There's no better example of the long way low-end dot matrix printers have come than the $289 9-pin Panasonic KX-P1091i. An upgrade of the $399 KX-P1091, which was an Editor's Choice in 1985, the 99-cps KX-P1091i offers more features and fonts, has an improved control panel, and is faster, cheaper, and quieter than its award-winning predecessor. Built-in friction- and tractor-feed mechanisms allow the printer to accept both single-sheet and fanfold paper; Epson and IBM emulations add to its versatility. At a list price that's hard to beat, the Panasonic KX-P1091i is the ideal low-end dot matrix printer for small-business, college, and home use.

Among mid-range 24-pin printers, upgrades are also in the spotlight. The $799 Epson LQ-850 and the wide-carriage $1,099 LQ-1050 deliver the same high print quality that made last year's models, the LQ-800 and LQ-1000, Editor's Choices, but they do it faster and with more style for the same money. Respective measured speeds of 153 cps and 163 cps for the LQ-850 and LQ-1050 make these printers 24-pin pacesetters, and an auto-load paper-feed mechanism is one element of their smart design. Epson LQ-1500 and IBM Proprinter emulations round out the LQ-850 and LQ-1050's offerings. Like last year's models, no other 24-pin printer came close to the LQ-850 and LQ-1050's moderate price and high performance.

Slightly slower than the Epsons, the $1,295 145-cps C. Itoh C-715A more than compensates with its adaptability. Four credit-card-sized identity cards come with the wide-carriage 24-pin C-715A, allowing it to emulate the IBM Proprinter XL, Epson LQ-1000/LQ-1500, Toshiba P351, and Diablo 630 printers; additional identity cards are available for $49.95 each. With the kind of 16-character LCD control panel you'd expect to see on a laser printer (but often don't), a quick setup method, and a manual that includes a chapter on how to use the printer with nine popular software packages, the C-715A earns high marks for ease of use as well as versatility.

But, really, the quality of dot matrix printers has improved so dramatically—while prices have gotten more in line with reality—that almost any of the 65 printers we've evaluated is worth consideration.

clearly delineates the process. You can set the default font and character pitch by using the DIP switches, conveniently located in the front of the printer and under the top cover. Rather than giving you a cryptic chart, the manual includes separate sections with step-by-step instructions on how to set each switch.

The DIP switch settings control the font and the pitch that the printer uses as defaults when you first turn it on. You can use the front-panel buttons to change each setting as well as to select cartridge or downloaded fonts.

The printer's front panel consists of six buttons and a two-character LED. Besides changing font and pitch, the buttons put the printer on- and off-line, control form-feed and line-feeds, and select quiet mode. The LED indicators show power on, on-line status, quiet mode, paper end, and character pitch. In quiet mode the printer takes two passes to print a line. Paper End indicates that the Toshiba P351C is out of paper, and the buffer holds unprinted data.

The Toshiba P351C manual is divided into two sections: Setup and Operation, and Technical Reference. The setup information includes a discussion of how to use the printer with *MultiMate*, *MultiMate Advantage*, *WordPerfect*, *WordStar*, *Microsoft Word*, and Lotus's *1-2-3*. The two sections of the manual have separate tables of contents, but they share a single index. A stiff divider tab placed at the beginning of the Technical Reference section and a heavy-stock quick-reference card would improve the manual.

The Toshiba P351C delivers good-quality print, high-speed draft, and fast graphics. Also, its rugged construction makes it suitable for heavy use. Although the Toshiba P351C can't perform every aspect of printing as well as individual printers that excel in one aspect can perform their speciality, it's a good compromise in a world where no printer is—as yet—perfect.—**Bruce Brown**

Toshiba P321SL and P341SL

The Toshiba P321SL and P341SL are narrow- and wide-carriage versions of Toshiba America's entry-level 24-pin dot matrix printer, selling for $749 and $999, respectively. What these built-to-last printers give you for your money are 120- and 125-character-per-second draft print, flexibility in using different fonts, easy-to-use front-panel controls, and some handy features.

The print speeds of the P321SL and the P341SL—120 cps in draft and 50 cps in near-letter-quality mode for the P321SL, 125 cps in draft and 52 cps in NLQ for the P341SL—put them solidly in the running with similarly priced printers. When you factor in the print quality they attain, the speed is even more impressive.

Besides the standard draft, NLQ, and condensed type, the printers have attractive built-in Courier and Prestige Elite fonts. You can add other fonts through plug-in font cards and by downloading fonts from software.

The machines have two front slots for the credit-card-sized font cards that Toshiba sells for $79 each. The printers' stan-

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■ DOT MATRIX PRINTERS

dard 32K memory can hold two more fonts downloaded from disk, and the vendor sells multiple-font disks for $35 each. You can have up to nine fonts available at one time, including internal, card, and downloaded fonts. That's a lot of flexibility.

The front-panel menu control system takes the place of DIP switches. Using the panel's six buttons and 16-character LCD window, you can select font, pitch, quiet mode, lines per inch, page length, line- and paper-feed settings, communications parameters, character sets, and graphics modes. You can also use the menus to activate the optional sheet feeder, switch from bidirectional to unidirectional printing, and change emulation modes.

The printers offer Qume Sprint 11 or IBM Proprinter/Graphics Printer emulation as well as Toshiba emulation. One of the two font card slots can also accommodate an emulation card. Both machines passed the IBM Proprinter compatibility tests for text and graphics and printed the IBM high-order character set.

Setting up the printers, which come with both serial and parallel ports, is problem-free. Inserting the ribbon couldn't be easier. Loading paper is also easy, using the auto-load button on the front panel.

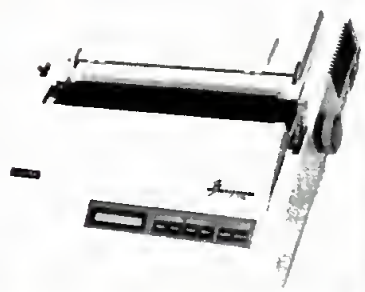
The P321SL and the P341SL handle both single-sheet and continuous-feed paper, using an internal bidirectional tractor for the latter. The tractor is hidden from sight below the rear top panel, which also has a built-in sound baffle that keeps the noise level in the 68- to 72-decibel range. A handy feature is the printers' ability to print on a single sheet of paper without requiring you to remove paper loaded in the tractor mechanism.

The manual's first section, Setup and Operations, includes plenty of helpful photographs. The longer, second section, Technical Reference, gives complete information about all the features and functions. A removable quick-reference page serves as a "cheat sheet" for using the front-panel menu.

The Toshiba P321SL and P341SL are both fine for small companies and departments that don't need a massive machine with super-high-speed or super-high-quality printing but do need graphics capability. They're both also good multipurpose printers for those who want to move up from a 9-pin dot matrix printer but don't want to spend a lot more money. But if you have both the extra 6 inches of desk space and the extra money, the wide-carriage P341SL is the better long-term investment.—**Bruce Brown**

The Toshiba P321SL and P341SL are both fine for small companies and departments that don't need a massive machine with super-high-speed or super-high-quality printing but do need graphics capability.

PC MAGAZINE FACT FILE



Toshiba P321SL and P341SL
Toshiba America Inc.
Information Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 380-3000
List Price: P321SL, $749; P341SL, $999.
Dimensions (HWD): P321SL, 3.9 × 16.3 × 15 in.; P341SL, 3.9 × 22 × 15 in.
Weight: P321SL, 17.5 lbs.; P341SL, 21 lbs.
In Short: These 24-pin dot matrix printers, narrow- and wide-carriage models of the same sturdy multipurpose machine, offer 120- and 125-cps draft, the ability to use up to nine fonts at one time, front-panel controls, and some handy features.

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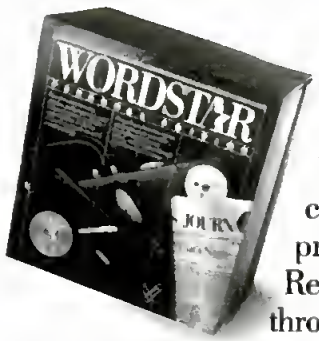
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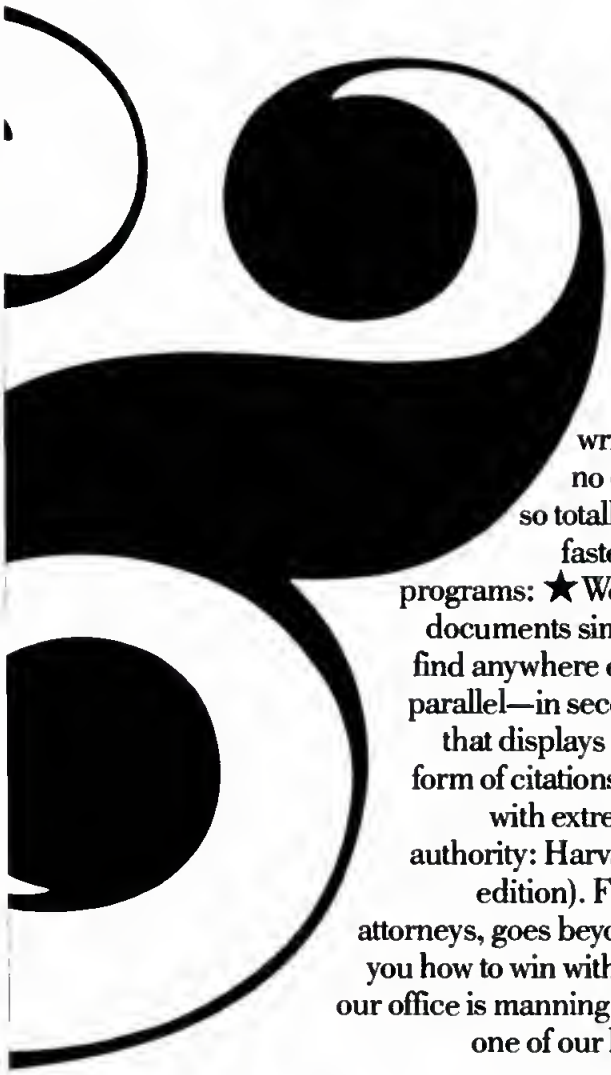
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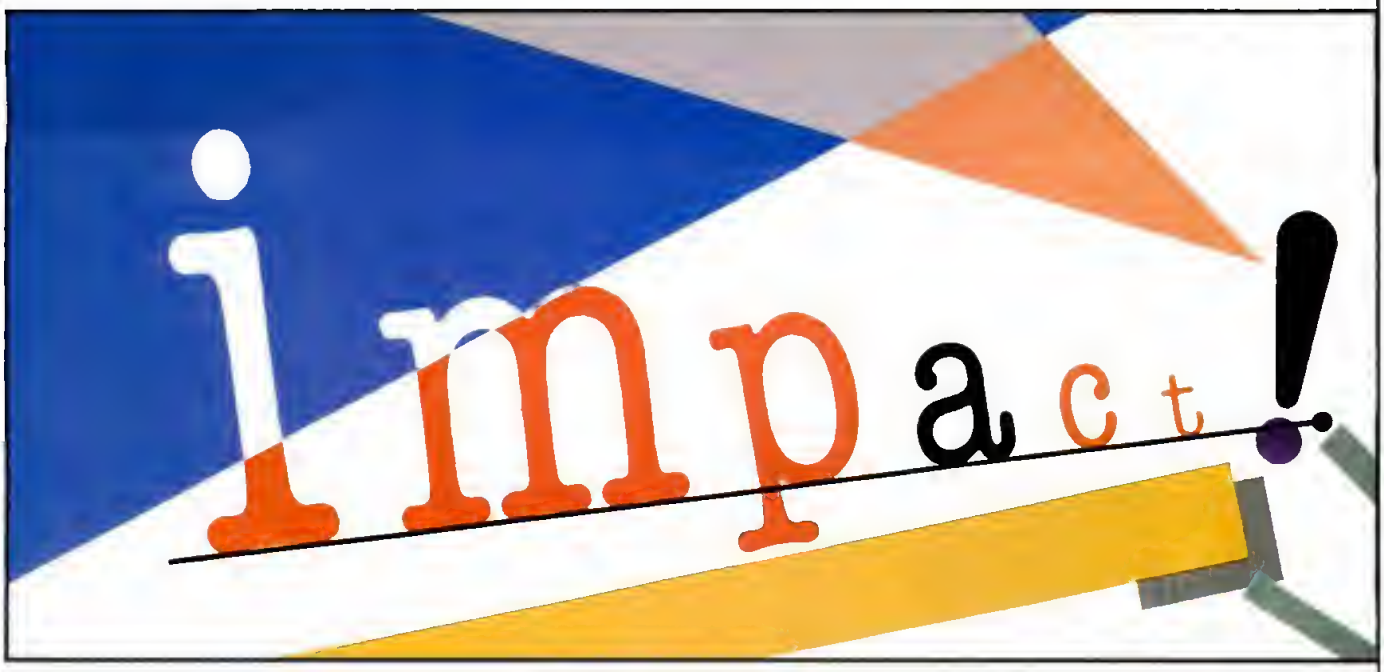


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A FAREWELL

From the fast-narrowing field of daisy wheel printers, PC Labs reviews five machines that belong to a vanishing breed.

With list and street prices of many laser printers falling below $2,000, and with most dot matrix printers offering respectable letter quality output, why would anyone buy a daisy wheel printer? The answer is the same as it's always been: for the print quality.

Rumors of the death of the noisy, slow daisy wheel printer have not been greatly exaggerated. The number of daisy wheel printers continues to dwindle at a brisk pace, dropping down to only five models in this year's roundup from 12 in last year's issue and 15 in the issue before that. While the number of new dot matrix printers *PC Magazine* has reviewed has remained almost constant over the past 2 years, the number of laser printers has exactly doubled—from 18 in Volume 5 Number 19 to 36 in this year's issue.

In light of these numbers, it would be difficult for anyone to argue that the future of formed-character daisy wheel printers doesn't look bleak. Nor does it take a great deal of foresight to see that the vastly improved performance of dot matrix printers combined with the large number of fonts being offered with laser printers will continue to push daisy wheel printers the way of wood-block type.

WHEN QUALITY MATTERS But there are reasons why you should consider buying a daisy wheel printer. Above all is the high quality of the output that it produces. Often referred to as "Selectric quality" for their similarity to the output of an IBM Selectric typewriter, the sharply defined characters produced by daisy wheel printers are created when a formed character strikes a ribbon, depositing ink on the page in the same way that a typewriter



TO DAISY WHEELS

would. Although many dot matrix printers can generate letter quality text, you can still tell even the best dot matrix samples apart from the crisp, clear output of a daisy wheel printer.

Laser printers, on the other hand, offer high-resolution output (at least 300 dots per inch) in any number of fonts, but the documents these printers produce look as if they came off a copying machine—at least until you get used to them.

True, the increasing number of new laser printers indicates that PC users want the variety of fonts and high-resolution graphics that lasers offer, and they are willing to sacrifice Selectric quality to get them. But for those times when nothing less than the look and feel of a document printed by a formed-character machine will do, the obvious choice is a daisy wheel. For example, if you're in charge of fund development for a non-profit corporation and you're soliciting donations from CEOs of the Fortune 500, you don't want your letters to look as if they're fresh off a copier.

That leaves a niche, albeit a small one, for such daisy wheel printer manufacturers as Primages and Brother International Corp. to fill. While claiming that the daisy wheel market is price insensitive, Primages has slashed its prices: the Primage 90-GT, which is basically the same printer as one of last year's Editor's Choices, the Primage 100, sells for $1,095—$800 less than its predecessor. However, the cost of an additional tractor-feed mechanism ($295), cut-sheet-feeder ($395), or dual-bin envelope-feeder ($795) undercuts the price advantage the Primage 90-GT has over some laser printers.

Brother International is going after users of laser printers who need machines that can handle the chores that lasers can't do well or can't do at all. As a spokesman for Brother points out, laser printers aren't well suited to printing envelopes or labels, and they can't print multipart forms at all. They are also limited to using 8.5-inch-wide paper.

Brother is more than ready to supply you with wide-carriage daisy wheel printers like the HR-40 ($799) or the HR-20 ($499) for those purposes. Although similarly priced dot matrix printers can handle the same tasks as these midrange entries, chances are their NLQ modes won't measure up to the high-quality output produced by these daisy wheels. In addition, some dot matrix printers slow down to about the same speed as daisy wheels when they print in NLQ mode, clocking in at approximately 35 characters per second.

Illustration: Javier Romero

PICKING THE RIGHT DAISY If you've decided that daisy wheel technology is what you need, you'll definitely want a printer that emulates the de facto standard in daisy wheel printers—the Diablo 630—but it's hard to find a new daisy wheel printer that doesn't. Print speed is based largely on how much you're willing to pay. In this year's crop of printers, speeds range from 16 cps for the $419 Panasonic KX-P3131 to 56 cps for the $1,095 Primage 90-GT.

Most important, remember that print quality is the only reason to buy a daisy wheel printer. Of the printers reviewed here, all provide true Selectric quality or very close to it. Don't settle for anything less. In addition, machines that offer a range of print wheels will afford you greater variety in the pitches and typefaces you can use.

Daisy wheel printers are an endangered species and may soon become extinct. But be assured that in demanding a daisy wheel printer, you're showing your good taste. When you care enough to print the very best, a daisy wheel printer is still the only choice. Reviews of five diehards follow; read about them while they last.

—M. David Stone

Brother HR-20

Conventional wisdom may have it that the noisy, slow, and limited daisy wheel printer bears some resemblance to the dinosaur and will suffer the same fate. But for some users, daisy wheel printers, like the $499 Brother HR-20 from Brother International Corp., still offer the best combination of print quality, typeface selection, and price/performance ratio.

The HR-20 uses Brother's interchangeable cartridge system. The print wheels are contained in plastic cartridges, and changing typefaces is as simple as snapping out one cartridge, snapping in another, and flipping a DIP switch or two if necessary. The cartridges not only simplify font and typeface selection but also prevent you from getting ink all over your hands when changing wheels. Brother has a selection of 25 cassettes at $24.95 each.

The Courier typeface that I tested with the Brother HR-20 is suitable for correspondence, reports, or any other text-only application. And although daisy wheel printers lack some of the text enhancement features of dot matrix or laser printers, the Brother HR-20 offers shadow print for boldface printing, double-strike mode for extra-dark printing, and underlining.

Of course, daisy wheel printers are slow, and the Brother HR-20 is no exception. But for many users, superior print quality is more important than high speed. We clocked the Brother HR-20 at 21 characters per second (cps) in standard mode. In double-strike mode, its speed dropped to a crawl—about 7 cps. But the extra-dark text produced in double-strike mode is worth waiting for if you are printing short documents, such as business letters or resumes.

Neither a tractor-feed nor a sheet-feeder is included in the Brother HR-20's base price of $499, which limits it to handling single cut sheets in its basic form. That won't be adequate for most users, who will need to purchase either the $169 tractor-feed or the $299 cut-sheet-feeder. The cut-sheet-feeder works very well; it moves the paper smoothly through the printer and up to its stacker. I had no problem with stray sheets or jamming.

While Brother didn't see fit to include a paper-feed, the vendor does supply both parallel and serial interfaces as standard equipment with the HR-20.

The Brother HR-20's front panel has switches for line-feed, top-of-form, and type pitch. The panel also has switches that control the HR-20's useful copy functions. Data can be loaded into the printer's 8K buffer (expandable to 16K) and then reprinted ad infinitum at the touch of a microswitch.

Neither dot matrix nor laser printers can beat the letter quality that a relatively inexpensive daisy wheel printer like the Brother HR-20 produces. So if you need to print only text, why spend more?

—Jonathan Matzkin

FACT FILE



Brother HR-20
Brother International Corp.
8 Corporate Pl.
Piscataway, NJ 08854
(800) 526-3537
(201) 981-0300
List Price: $499; tractor-feed, $169; cut-sheet-feeder, $299; additional daisy wheel cartridges, $24.95.
Dimensions (HWD): 5.5 × 18 × 13.5 in.
Weight: 18.5 lbs.
In Short: A basic wide-carriage 21-cps personal daisy wheel printer that uses easy-to-replace print wheel cartridges.

CIRCLE 659 ON READER SERVICE CARD

Brother HR-40

With the $799 Brother HR-40, Brother International Corp. upholds its tradition of producing low-cost, high-quality daisy wheel printers. The Brother HR-40's speed and print quality are unexpected for the price and a match for the high-end daisy wheel printers that once ruled the letter-quality market.

The printer also boasts such pluses as a built-in cut-sheet-feeder and tractor-feed. And because the Brother HR-40 uses Diablo 630 control codes, you can use it with most applications software without encountering problems.

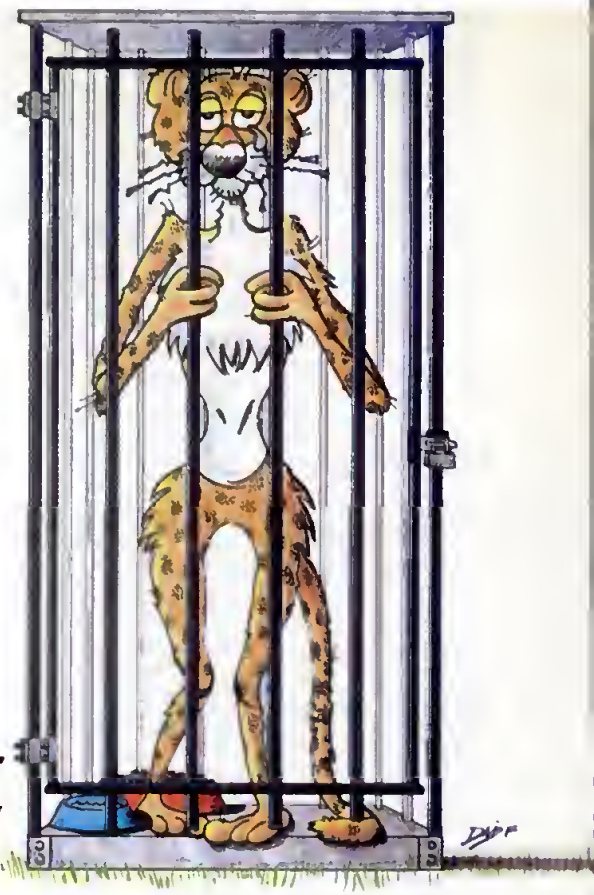
Print quality on the Brother HR-40 falls just short of true IBM Selectric typewriter quality. Characters are crisp and clean; they're not uniformly dark, but they're fine for most types of correspondence.

The Brother HR-40's print speed is also good for a daisy wheel printer. On the PC Labs tests the printer clocked in at 31 characters per second (cps). This speed is roughly half that of the fastest daisy wheel printer ever tested at PC Labs (it also sells for well under half the price).

The Brother HR-40's built-in multiple approach to paper handling is a nice touch. As shipped, the printer can take single

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—M. Bryan, LOTUS Magazine

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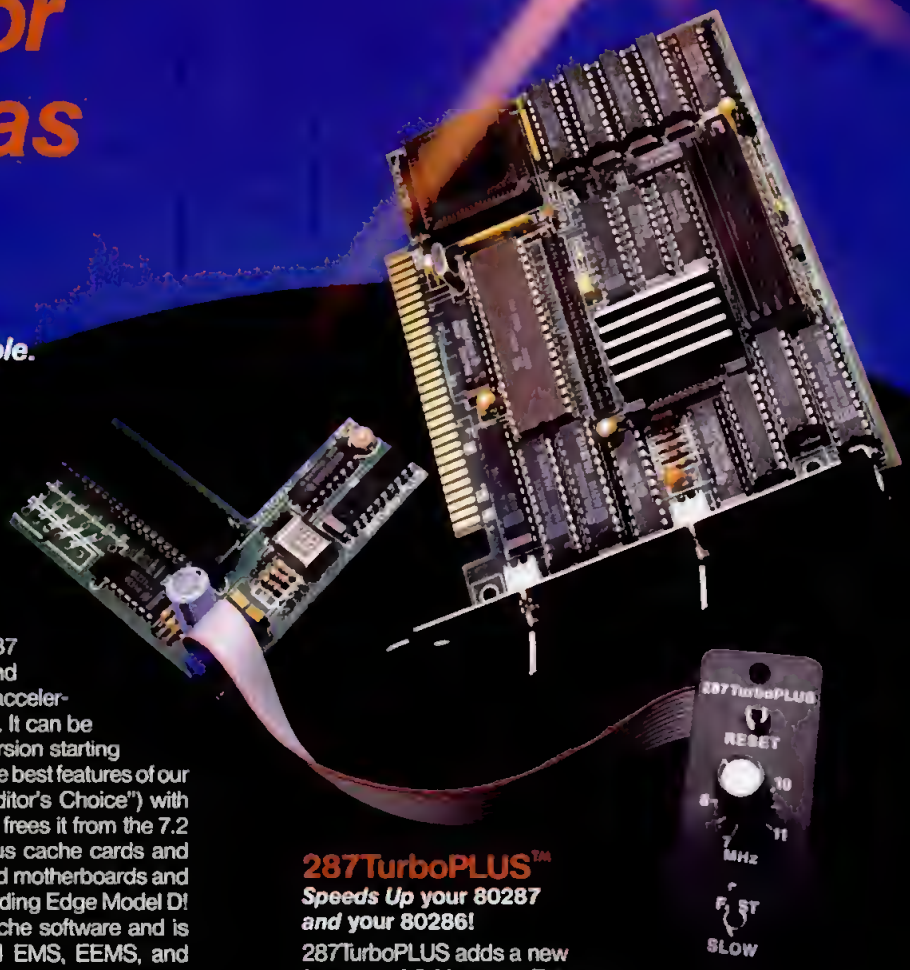
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sheets with manual insertion, single sheets through the built-in cut-sheet-feeder, or continuous forms through the built-in tractor-feed. If you have to shift among different kinds of paper regularly, you'll appreciate this flexibility.

The built-in sheet-feeder is strictly for letter-sized paper, and it holds only 50 sheets. For heavy-duty printing, you'll probably want the optional dual-bin sheet-feeder, which holds 125 sheets of 20-pound paper, up to 14 inches wide, in each bin and offers an optional envelope-feeder as well.

MODERN LOOK The Brother HR-40 sports a suitably modern squarish look. The seven front-panel buttons have the usual settings for on- and off-line, line-feed, and top-of-form. Another button sets pitch (10, 12, 15, or proportional type).

The reprint button, which you use when you want to print multiple copies of documents, is another interesting feature. To use the reprint feature, you put the printer off-line and push the copy button to put it in copy mode. Then you go on-line and print as usual. After printing the first copy, you simply go back off-line and print as many additional copies as you need merely by hitting the reprint button once for each copy.

> The HR-40's reprint feature helps make up for the slow speed of a daisy wheel printer, since it frees the computer for other jobs.

The reprint feature helps make up for the relatively slow speed of a daisy wheel printer, since it frees the computer for other jobs once the printer has produced the first copy. Unfortunately, the feature is useful only for printing short documents, since the Brother HR-40 comes with only 8K of memory, expandable to just 16K.

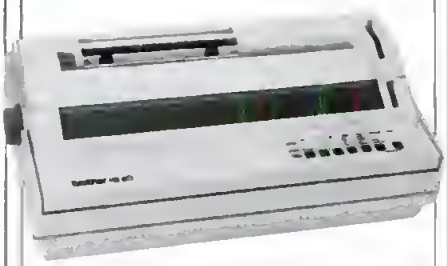
Even when using the reprint feature, you may find it difficult to work on your freed-up computer. Like most daisy wheel printers, the HR-40 has a relatively high noise level. It clatters along at a distracting 71 decibels.

Another innovative feature found in the HR-40 is the Diablo 630 ECS compatibility mode. Most standard daisy wheel printers cannot print the IBM high-order characters because they can print only one character per spoke, and they only have either 92 or 96 spokes. The Diablo 630 ECS puts two characters on each spoke, with the standard characters at the end of the daisy wheel petals and the high-order characters half-way up. Brother International offers a print wheel that can duplicate the Diablo 630 ECS feat by overprinting certain characters with others. According to the vendor, printing the high-order characters is simply a matter of putting the proper print wheel in the printer, setting a DIP switch for Diablo 630 ECS mode, and printing as usual.

The clear, straightforward instruction manual for the Brother HR-40 gives you all the information you'll need to get the most from the machine. Installation and paper handling are detailed step by step with careful explanations, complemented by illustrations. And the manual discusses control codes thoroughly.

At $799, the Brother HR-40 is worth investigating if you need true letter-quality output—on a tight budget. But its real market may be for laser printer owners who need a second printer to handle labels, envelopes, and multipart forms or wide printouts. So if you're looking for a reasonably priced printer to supplement your laser, your search may come to a successful close when you encounter the Brother HR-40.—**M. David Stone**

PC MAGAZINE FACT FILE



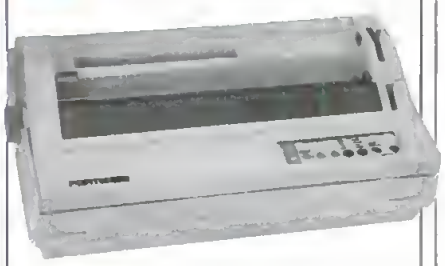
Brother HR-40
Brother International Corp.
Information Systems Div.
8 Corporate Pl.
Piscataway, NJ 08854
(201) 981-0300
List Price: $799
Dimensions (HWD): 7.7 × 23.1 × 13.4 in.
Weight: 31.9 lbs.
In Short: This impressive-for-the-price wide-carriage daisy wheel printer offers 31-cps speed, high-quality printing, a built-in cut-sheet-feeder, a built-in tractor-feed, and a handy reprint feature.
CIRCLE **681** ON READER SERVICE CARD

Fortis DX41

The Fortis DX41, a $699 wide-carriage daisy wheel printer from Fortis Information Systems, has a raft of bells and whistles that make it functionally enticing.

In addition to the three typical front-panel controls—on/off-line, line-feed, and top-of-form—the Fortis DX41 has a control called Copy Mode/Reprint. This function allows the printer to store data in a buffer as it is being printed; you can then

PC MAGAZINE FACT FILE



Fortis DX41
Fortis Information Systems Inc.
6070 Rickenbacker St.
Commerce, CA 90040
(213) 727-1227
List Price: $699
Dimensions (HWD): 7.7 × 23.1 × 13.4 in.
Weight: 31.9 lbs.
In Short: This wide-carriage daisy wheel printer has slightly above-average printing capabilities (at 31 cps in bidirectional printing) and some handy extra features, including the ability to reprint copies by reading from its buffer.
CIRCLE **636** ON READER SERVICE CARD

reprint it minutes or hours later (any time before turning the printer off). With Copy Mode/Reprint, the computer can go about its own work while the Fortis DX41 prints out copies, reading from its buffer.

To the right of Copy Mode/Reprint in the front panel is a control for a function called Load. Here you select the type of paper: cut-sheet or fanfold.

In some printers, automatic paper loading is akin to one-button ignition systems on backyard gas barbecue grills: they're faulty, and within a week or two the function is disabled. The Fortis DX41, which emulates the Diablo 630, is different. Using an automatic paper-feeding system controlled by a touch-sensitive switch, the printer loads forms from the excellent single or dual cut-sheet-feeders or the built-in tractor-feed.

Another good design feature is the location of the DIP switches. Frequently, DIP switches are put somewhere in the rear of printers, buried behind and beneath cables and plastic ridges; it's as if the manufacturers searched for the most awkward spot in which to bury the minuscule switchboards. To its credit, the DX41 eschews this design course. Its DIP switches are underneath the top front cover, where you can see and use them easily.

The print wheels for the Fortis DX41 are tiny plastic cassettes that both prevent the encased printing elements from being damaged and ensure that ink doesn't stain your fingers. A joy to work with, they slide in and out smoothly.

When it comes to printing capabilities, though, the Fortis DX41 is only slightly above average. In low-speed near-letter-quality mode, it prints solid, strong characters. It offers bold, proportional, and compressed modes as well as underlined characters, but it lacks italics as well as superscripts and subscripts. In proportional printing, the letters appear to be bunched too tightly.

In terms of speed, the DX41 is typical of other printers in its class. In bidirectional printing, it clocked in at 31 characters per second; Fortis claims a maximum of 40 cps for the machine. In tests for unidirectional printing, the Fortis DX41 came in at 19 cps.

Considering that excellent user manuals accompany the Fortis line of dot matrix printers, the documentation for this daisy wheel is disappointingly sparse and incomplete. What's more, the section that details the use of control codes lacks sample BASIC runs and even examples of the type styles and enhancements.

The Fortis DX41 offers a few unusual conveniences, most notably its Copy Mode/Reprint and automatic paper-loading features. But don't expect exceptional print capabilities; in that respect the Fortis DX41 is only slightly better than most daisy wheel printers in its class.

—Jeffrey Rothfeder

Panasonic KX-P3131

A sturdy, easy-to-operate, well-priced ($419), almost-wide-carriage daisy wheel printer from that superb market competitor, Panasonic Industrial Co., the Panasonic KX-P3131 is a trustworthy performer in office and home environments. The printer is especially distinctive because it's extremely lightweight (only 19.7 pounds). Its basic design is simple, not overwhelming, and its footprint is small enough to fit in most workstation areas.

The Panasonic KX-P3131's output is smart, if not stylish. In the default font we tested (Courier 10), certain letters, such as *r* and *e*, appear a bit ragged and soft, but overall the print looked good, without being overly inky, as is the output of many daisy wheels.

Although the KX-P3131 costs significantly less than do other daisy wheels, this printer's speed is nothing to keep secret. We clocked it at 16 characters per second (cps) in unidirectional printing, while Panasonic's testers claim 17 cps.

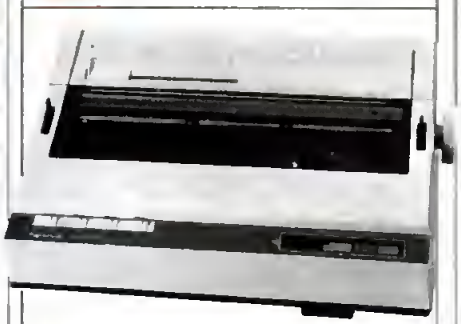
Typical printer enhancements such as bold type, underlining, and proportional printing are available. Particularly pleasing is the way the printer handles proportional type. The letters do not lean on each other, but seem to have a well-separated space in which to sit—a sign of a well-designed daisy wheel machine. Moreover, the Panasonic KX-P3131 also offers such nontypical type enhancements as outlining and shadow print.

The types of switches and indicators on the printer, as well as their location, are another plus. The DIP switches are conveniently located under the front top cover, where they are easy to see and use. Moreover, the usual function switches—on/off-line, form-feed, line-feed—are enhanced by a second set of selector switches that enable you to set margins and justification, choose type pitch, select line spacing, and indicate how heavy or light the output should be.

In addition, the Panasonic KX-P3131's user manual is excellent. It begins with a concise, interesting explanation of what daisy wheel printing is all about. A step-by-step, comprehensible guide to setting up the printer and loading paper follows. Finally, control codes for type enhancements and special printer functions are illustrated through sample BASIC programs and samples of the output produced when the programs are run. If that's not enough, well-organized appendexes and an index make the information easy to find when you need it.

If, despite the manual's help, you still need assistance, knowledgeable technical-

PC MAGAZINE FACT FILE



Panasonic KX-P3131
Panasonic Industrial Co.
One Panasonic Way
Secaucus, NJ 07094
(800) 222-0584
(201) 348-7000
List Price: $419
Dimensions (HWD): 6.6 × 18.9 × 12.8 in.
Weight: 19.7 lbs.
In Short: This lightweight 13.5-inch-carriage daisy wheel printer outperforms heavier, more expensive printers; at 16 cps it's no speedster, but it's a trustworthy machine for home or office.

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support representatives will respond to your calls. And Panasonic's technical-support phone number is toll free.

One drawback to the machine: in the interest of making a compact printer, Panasonic made the KX-P3131 too narrow. It does not accept paper wider than 13.5 inches. And although the company claims that the printer is wide enough for most invoices and spreadsheets, you won't be able to use the wider tractor-feed computer paper, which is 14⅞ inches. If your printing needs are frequently in the wide-carriage range, this narrowness of vision in the design of the KX-P3131 could be the reason why you'll decide to choose another daisy wheel printer.

That problem aside, however, the Panasonic KX-P3131 is a contender for your printer budget, particularly if pure price and printing performance measurements are your guide.—**Jeffrey Rothfeder**

Primage 90-GT

The Primage 90-GT daisy wheel printer is Primages' $1,095 answer to the falling price of laser printers. It's essentially the same printer as last year's Primage 100, a *PC Magazine* Editor's Choice. The Primage 100 offered high-quality output at high speed. It also offered Epson-compatible graphics—a feature virtually unheard of among daisy wheel printers. Alas, its price of $1,895 forced it to compete with low-end laser printers.

This year's Primage 90-GT differs essentially only in that it has 2K memory instead of 8K and offers a parallel connector as standard, rather than both a parallel and a serial connector. These two changes allowed Primages to reduce the price to $1,095, less perilously close to laser price territory.

Print quality is a strong point of the Primage 90-GT. Previous models of Primages printers have always fallen just short of true IBM Selectric typewriter quality, but the 90-GT closes the gap. In fact, the Primage 90-GT output is indistinguishable from IBM Selectric output.

Its secret is a new ribbon cartridge—the Jogger, a variation on a Diablo Hytype II cartridge. (You can use any Hytype II–style cartridge with the 90-GT, but print quality will suffer. You can also use the Jogger cartridge on any printer that will take the Hytype II cartridges.)

Previous models of Primages printers have always fallen just short of true IBM Selectric typewriter quality, but the 90-GT output is indistinguishable from IBM Selectric output.

The ribbon on most carbon ribbon cartridges moves less than a full character width for each character the printer produces. But as the Jogger moves the ribbon through the printer, it also moves it up and down. Thanks to the vertical motion, the Primage 90-GT strikes a different part of the ribbon with each character, and the output is far crisper and cleaner than that produced using other cartridges. The Jogger cartridge also has a sensor that alerts the printer to stop printing if the ribbon breaks.

Speed is another strong point of the Primage 90-GT. On the PC Labs speed test, the printer managed 56 characters per second (cps) for letter-width paper (compared with just over 60 cps for the fastest daisy wheel printer ever tested at PC Labs). On the wide-carriage test, the Primage 90-GT scored 53 cps.

QUIET PRINTING Noise level is the Achilles' heel of most daisy wheel printers. If you're printing all day long, you won't want to share an office with one. But Primages printers have always been quieter than most, and the Primage 90-GT upholds that tradition, producing only a mild clatter.

The only time printer noise may drive you from the room is when printing the Epson-compatible graphics. If you have any solid black areas in the graphic, the sound quickly becomes unpleasant as the printer slams the spokes against the paper. The difference between printing text on this printer and printing graphics is like the difference between having a jackhammer that's two blocks away and having one at your front door.

Despite the noise, the graphics are impressive. The printer has both a Diablo-compatible mode and an Epson-compatible mode. To switch between them, you turn the printer off and change an easily accessible DIP switch. You then turn the printer back on, set your program for an Epson printer, and print the graphic. Primages claims that the graphics mode is Epson FX compatible, but on the PC Labs test, the Epson MX graphics worked much better.

As you'd expect, printing graphics with the Primage 90-GT takes a long time and chews up a great deal of ribbon. The graphics feature is obviously only for occasional use. But if your main concern is high-quality text and you need graphics only rarely, you can get by using just the Primage 90-GT.

Graphics produced with the Primage 90-GT are better than they appear in the sample. The printer's daisy wheel technology produces extremely dark graphics,

PC MAGAZINE FACT FILE



Primage 90-GT
Primages Inc.
151 Trade Zone Dr.
Ronkonkoma, NY 11779
(516) 585-8200
List Price: $1,095
Dimensions (HWD): 7.4 × 24.5 × 15.5 in.
Weight: 53 lbs.
In Short: This wide-carriage daisy wheel offers 56-cps speed, low noise level, IBM Selectric-quality output, Epson-compatible graphics, and Diablo-compatible control codes for text—a surprising lineup for any daisy wheel printer and impressive for the price.

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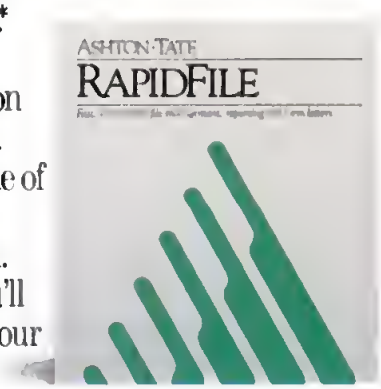
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CIRCLE 269 ON READER SERVICE CARD

■ DAISY WHEEL PRINTERS

PC MAGAZINE EDITOR'S CHOICE

- **Too few choices**

Last year we selected three Editor's Choices from a field of 12 daisy wheel printers—the $1,895 Primage 100 for its Epson-compatible graphics, the $899 Qume LetterPro Plus for its 41-cps (character-per-second) letter quality speed and low cost, and the $1,495 Fujitsu SP320E for its full-sized carriage and quiet operation. This year, each of the five daisy wheel printers tested offers Selectric- or near-Selectric-quality output, all but one have wide carriages, and their noise level is on a par with that of dot matrix printers. However, with only five daisy wheel printers from which to choose, the category has become too limited to support an Editor's Choice.

and so for best results you should set your graphics program for single-density printing. The PC Labs tests, which assume that darker is better, are designed to print graphics in quadruple density. This practice makes sense for most printers, but for the 90-GT it causes the graphics to look less detailed.

The Primage 90-GT's boxy look is beginning to look a bit dated, but it will still look at home with most office decors. The user manual contains most of the information you'll need, and if you run into problems, the company provides knowledgeable technical support. Also, a noteworthy $795 triple-bin sheet-feeder is available, as well as a $395 single-bin sheet-feeder and a $295 tractor-feed.

If you're faced with the choice of a laser printer or the Primage 90-GT, the laser will probably triumph over the daisy wheel. But if a daisy wheel will answer more of your needs, you'll find that the Primage 90-GT, son of last year's Editor's Choice, offers more features at a lower price than you'll find elsewhere.

—M. David Stone

It's not if you'll lose data.

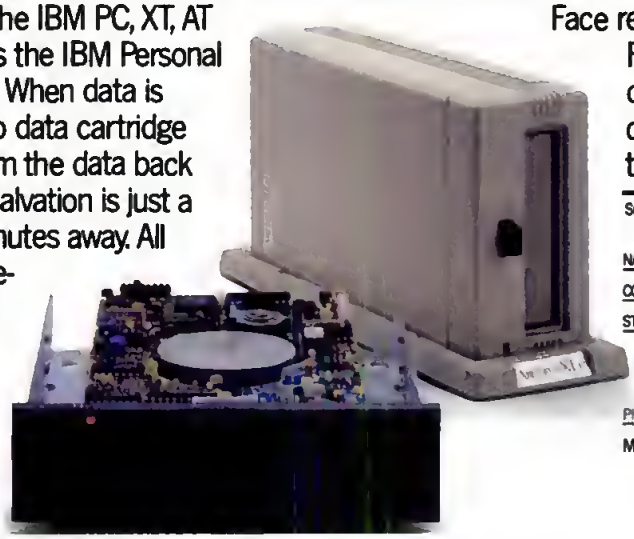
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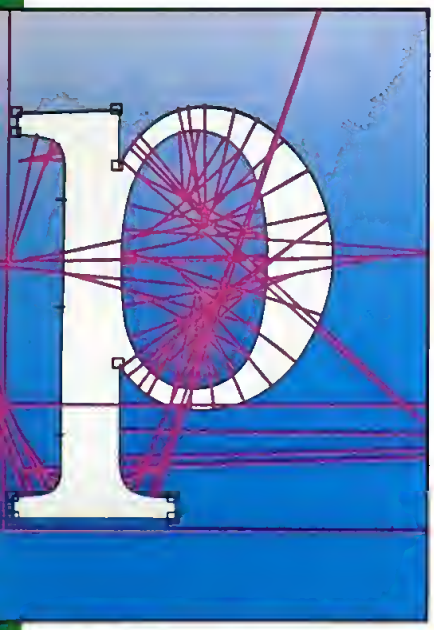
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Take a look at the first typefoundry-quality fonts for IBM users that can be scaled to any size.



Bitstream explains, "Fontware is composed of expert software and intelligent font outlines encoded with typographic rules."



"These rules are used to generate high quality bitmaps in which consistency of stroke weights and other typographically significant features are maintained."



"The essentials of good type design — shape, spacing, weight, rhythm — are preserved at all sizes and resolutions."



SoftCraft has incorporated Bitstream's Fontware™ program into their extensive collection of personal typesetting software. This program utilizes Bitstream® Fontware outlines to produce fonts, giving you an unlimited number of sizes, the very best font quality and a large number of professional typefaces.

Fonts can be produced in any size from 3 to 120 points. The most common sizes can be produced automatically, with no interaction required. Otherwise, simply specify the size, type of printer, font file format, and symbol set (such as *Roman-8*, *IBM-PC*, or *foreign languages*) and the SoftCraft Fontware Installation Program does the rest.

There are currently 80 typefaces available and many more soon to come from Bitstream, including new typefaces specially designed for laser printers.

Font files can be produced in HP soft font format (*portrait* and *landscape*) for use with the many printers and desktop publishing packages that use this standard format. Or produce fonts in SoftCraft format for use with SoftCraft printing programs on laser and dot matrix printers.

Works with any IBM or MS-DOS computer with MS-DOS or PC-DOS 3.1 or later. Requires 512K memory and a hard disk. The SoftCraft Fontware Installation Program is $95 and the Bitstream Outline Packages are $200 for a set of four typefaces.

SoftCraft products let you take full advantage of these fonts.

SoftCraft's Laser Fonts™ program downloads fonts into laser printers and automatically configures Microsoft® Word, Word Perfect and Wordstar 2000® to use the downloaded fonts. Fancy Font® can be used with any program that can produce an ASCII file to print the large fonts produced with the Fontware Installation Program. Fancy Word® works with Microsoft Word to print graphics and fonts up to 120 points. SoftCraft also has an extensive library of low-cost bitmap fonts ($15/disk).

The headlines and copy in this ad were set in Bitstream's version of Times Roman, and printed with Fancy Font on an HP LaserJet+.

TYPEFACES

Each Outline Package includes four typefaces, usually roman, italic, bold and bold italic

Dutch 801. Bitstream's version of the Times Roman® typeface.
Swiss 721. Bitstream's version of the Helvetica® typeface.
Courier
Headlines: Cloister Black,® Bitstream's **Cooper Black**, **Broadway**,® the Universally Roomy® typeface.
Swiss 721 Condensed
Swiss 721 Light
Letter Gothic
Prestige
Zapf Calligraphic. Bitstream's version of the Palatino® typeface.
Zapf Humanist. Bitstream's version of the Optima® typeface.
Century Schoolbook®
ITC Souvenir®
ITC Garamond®
ITC Avant Garde Gothic®
ITC Galliard®
ITC Korinna®
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SoftCraft, Inc.
16 N. Carroll St., Suite 500, Madison, WI 53703
(608) 257-3300 1-800-351-0500

CIRCLE 726 ON READER SERVICE CARD

BEYOND LETTER QUALITY

If the question is how to get more typographic variety out of an HP LaserJet, then soft fonts may just be the answer. Here's a rundown of what they are and how to use them.

Not too long ago, the best print quality you could expect was letter quality, and the only printer that could do the job was a daisy wheel. The 1984 introduction of the $3,495 Hewlett-Packard LaserJet changed all that, but it took a few more years before even Hewlett-Packard caught up to the standard it created and shook the formed-character mentality. In 1984, the LaserJet had only one typeface, and its solipsistic existence was a reminder of the limitations of PC printers past. Today, the $2,595 HP LaserJet Series II comes with Courier, Courier Bold, and Line Printer fonts in both portrait and landscape format as well as two cartridge slots, and Hewlett-Packard as well as other vendors offer a wide range of font cartridges and downloadable fonts. The message couldn't be clearer: the way to get your HP LaserJet to make the transition from mere letter quality to near-typeset quality is by expanding its font library.

Although some people still consider the touchstone of print quality to be the output produced by the IBM Selectric typewriter and other machines that use formed-character print elements, users of laser printers can achieve much more than that. Unlike typewriters or daisy wheel printers, laser printers can use their 300-dot-per-inch resolution to produce characters of almost any shape and size. Although 300-dpi characters are still no match for the output produced by typesetting equipment, they do an adequate job of reproducing many commonly used typefaces.

Until the invention of the typewriter, almost all typefaces were proportional; different characters consumed different amounts of space on the line, with the result that more characters could fit on a line. A lowercase "i," for example, might take up only one fourth the width of an uppercase "W." This kind of type is still the Old Faithful of high-quality typesetting and is considered to be easier to read than the monospace type used by most typewriters. Moreover, graphics designers have long been aware that a typeface can subtly convey a message and influence readability. For example, a serifed typeface like Times Roman, which includes ending strokes on the stems and tails of characters, connotes tradition and stability. Some designers believe that the serifs, which have a horizontal stress, help to lead the reader's eye across the page and, thus, reduce eye fatigue. It is the mixture of proportional typefaces in varying sizes and styles that gives laser printer output its near-typeset-quality appearance.

PC MAGAZINE FACT FILE

Bitstream Soft Fonts
Hewlett-Packard Co.
Boise Division
P.O. Box 15
Boise, ID 83707
(800) FOR-HPPC
List Price: $200
Requires: 256K RAM, one disk drive, DOS 1.0 or later.
In Short: Disk-based font definitions prepared by Bitstream that are downloadable into LaserJet Plus and compatible printers. Packages include the ITC Garamond family, Century Schoolbook family, Zapf Humanist family, and a Headline Typefaces collection. Not copy protected.
CIRCLE **451** ON READER SERVICE CARD

Fancy Font
SoftCraft, Inc.
16 N. Carroll St., #500
Madison, WI 53703
(800) 351-0500
(608) 257-3300
List Price: $180
Requires: 256K RAM, two disk drives, DOS 2.0 or later.
In Short: A standalone text formatter that uses embedded formatting codes to select soft fonts. Can merge graphics with text. Not copy protected.
CIRCLE **450** ON READER SERVICE CARD

Font Control
Polaris Software
613 W. Valley Pkwy., #323
Escondido, CA 92025
(619) 743-7800
List Price: $99
Requires: 256K RAM, two disk drives, DOS 2.0 or later.
In Short: A soft-font utility program that downloads up to 48 fonts as well as creates soft-font and cartridge printer drivers for *Microsoft Word* and *WordStar 2000*. Not copy protected.
CIRCLE **448** ON READER SERVICE CARD

Fontware Installation Kit
Bitstream Inc.
Athenaeum House
215 First St.
Cambridge, MA 02142
(800) 522-3668
(617) 497-7512
List Price: $95
Requires: 512K RAM, hard disk drive, one or more *Fontware* typeface packages, either *Microsoft Windows* (Version 1.03 or later) or *Ventura Publisher* (Version 1.1), DOS 3.1 or later.
In Short: Font-generation program that produces matching on-screen and printer fonts in sizes ranging from 3 to 120 points. Not copy protected.
CIRCLE **448** ON READER SERVICE CARD

Fontware Library
Bitstream Inc.
Athenaeum House
215 First St.
Cambridge, MA 02142
(800) 522-3668
(617) 497-7512
List Price: $195 per package.
Requires: 512K RAM, one disk drive, *Fontware Instollotion Kit*, either *Microsoft Windows* (Version 1.03 or later) or *Ventura Publisher* (Version 1.1), DOS 3.1 or later.
In Short: Font outlines that work with the *Fontware Installation Kit*. Available packages include versions of Times Roman and Helvetica, Century Schoolbook, ITC Souvenir, ITC Galliard, and many others. Not copy protected.
CIRCLE **447** ON READER SERVICE CARD

Glyphix
SWFTE International Ltd.
P.O. Box 5773
Wilmington, DE 19808
(302) 733-0956
List Price: $99.95 (includes four glyphs or four outlines); $99.95 for Power Pak package with four glyphs.
Requires: 64K RAM, one disk drive, DOS 2.0 or later.
In Short: A font-generation program that quickly creates and downloads high-quality regular fonts and somewhat lesser-quality boldface and italic fonts. Not copy protected.
CIRCLE **446** ON READER SERVICE CARD

Laser Fonts
SoftCraft Inc.
16 N. Carroll St., #500
Madison, WI 53703
(800) 351-0500
(608) 257-3300
List Price: $180
Requires: 128K RAM, two disk drives, DOS 2.0 or later.
In Short: A selection of 36 Bitstream-designed Times Roman, Helvetica, and Courier downloadable fonts, with two SoftCraft-designed decorative display fonts. The package also includes utilities for downloading the fonts and creating printer drivers for *Microsoft Word*, *WordPerfect*, and *WordStar 2000*. Not copy protected.
CIRCLE **445** ON READER SERVICE CARD

LaserWare
SWFTE International Ltd.
P.O. Box 5773
Wilmington, DE 19808
(302) 733-0956
List Price: $99.95
Requires: 50K RAM, one disk drive, DOS 2.0 or later.
In Short: A RAM-resident formatting program that uses embedded commands to invoke up to nine cartridge and downloadable fonts in a single document. Can also download fonts and merge text with graphics. Not copy protected.
CIRCLE **444** ON READER SERVICE CARD

Laser Word Processor Tool Kit
VS Software
P.O. Box 6158
Little Rock, AR 72216
(501) 376-2083
List Price: $150 (free with purchase of font families from *VS Library of Fonts*).
Requires: 256K RAM, two disks drives, DOS 2.0 or later.
In Short: set of handy utilities that can download soft fonts, create printer drivers for *Microsoft Word* and *WordPerfect*, and convert fonts from portrait to landscape orientation. Not copy protected.
CIRCLE **443** ON READER SERVICE CARD

PCLPak
Hewlett-Packard Co.
Boise Division
P.O. Box 15
Boise, ID 83707
(800) FOR-HPPC
List Price: $79 (free with purchase of selected *HP Soft Fonts* packages).
Requires: 256K RAM, two disk drives, DOS 2.0 or later.
In Short: A menu-driven laser printer utility that can handle setup chores, download fonts, and create and print ruled forms. Not copy protected.
CIRCLE **442** ON READER SERVICE CARD

RAM-Resident PrintMerge
Polaris Software
613 West Valley Pkwy., #323
Escondido, CA 92025
(619) 743-7800
List Price: $149
Requires: 98K RAM, two disk drives, DOS 2.0 or later.
In Short: RAM-resident formatting program that uses embedded commands to invoke up to 24 cartridge and soft fonts in a single document. Not copy protected.
CIRCLE **441** ON READER SERVICE CARD

SoftCraft Fontware Installation Program
SoftCraft Inc.
16 N. Carroll St., #500
Madison, WI 53703
(800) 351-0500
(608) 257-3300
List Price: $95
Requires: 512K RAM, hard disk drive, one or more SoftCraft *Outline Packages*, DOS 3.1 or later.
In Short: A licensed version of Bitstream's *Fontware*, the program creates bit-mapped soft fonts from a *SoftCraft Typefoundry Series Outline Package*. Not copy protected.
CIRCLE **440** ON READER SERVICE CARD

SoftCraft Standard Series Fonts
SoftCraft Inc.
16 N. Carrol St., #500
Madison, WI 53703
(800) 351-0500
(608) 257-3300
List Price: $15 per disk
Requires: One of the following SoftCraft products: *Laser Fonts*, *Fancy Font*, *Fancy Word*.
In Short: Downloadable soft fonts of varying quality in SoftCraft's proprietary font format. Not copy protected.
CIRCLE **439** ON READER SERVICE CARD

SoftCraft Typefoundry Series Outline Package
SoftCraft Inc.
16 N. Carroll St., #500
Madison, WI 53703
(800) 351-0500
(608) 257-3300
List Price: $195
Requires: 512K RAM; hard disk drive; *SoftCraft Fontware Installation Program*; one of the following: HP LaserJet Plus or LaserJet Series II, or *Fancy Font* and a *Fancy Font*–supported printer; DOS 3.1 or later.
In Short: Font outlines that work with the *SoftCraft Fontware Installation Program*. These are versions of the same outlines available in Bitstream's *Fontware Library*. Not copy protected.
CIRCLE **438** ON READER SERVICE CARD

Soft Fonts
Hewlett-Packard Co.
Boise Division
P.O. Box 15
Boise, ID 83707
(800) FOR-HPPC
List Price: $200
Requires: 256K RAM, one disk drive, DOS 1.0 or later.
In Short: Disk-based font definitions that can be downloaded into LaserJet Plus and compatible printers. Packages include Times Roman and Helvetica Base Set, Times Roman and Helvetica Supplemental Set, Letter Gothic Base Set, Prestige Elite family, and others. Not copy protected.
CIRCLE **437** ON READER SERVICE CARD

VS Library of Fonts
VS Software
P.O. Box 6158
Little Rock, AR 72216
(501) 376-2083
List Price: Ranges from $39.95 for a single-size typeface in several styles, to $179.95 for a complete font family.
Requires: 256K RAM, two disk drives, DOS 1.0 or later.
In Short: Disk-based font definitions that can be downloaded into supported printers. Library includes 34 typeface families, including designs licensed from Compugraphic Corp. and International Typeface Corp. Not copy protected.
CIRCLE **436** ON READER SERVICE CARD

To be used with a dot matrix device, such as a laser printer or a digital typesetting machine, a typeface has to be digitized. Although digitization techniques vary, the process used by Bitstream, a Cambridge, Massachusetts–based digital typeface design firm, is typical. At Bitstream, the digitization of a typeface begins with a graphic image of the typeface, which is either an original design or one of the classic typefaces in general use. A designer uses a computer to store key points of the outline of the character, thus creating a computerized outline of the typeface. The next step involves running a computer program that uses the outline to create bit-mapped fonts for different devices. The accuracy of the bit map, which describes the placement of each dot in each character, depends to some extent on the resolution of the output device, and to some extent on the precision of the bit-map construction program. At Bitstream, bit-mapped fonts are often edited by hand before they are ready for market.

Thus, not all bit-mapped fonts are created equal; how good they look depends on the quality of their execution and design. Although there are a number of technical criteria for judging font quality, in the end it boils down to whether the result "looks right." At best, laser printer fonts are barely distinguishable from the type you see in books and magazines. At worst, laser printer fonts have rough curves and jagged lines that create an unfinished appearance.

Moreover, not all laser printers are created equal. They vary greatly in the speed and ease with which they can produce different typefaces. Among the most powerful are PostScript printers like the Apple LaserWriter Plus, the NEC Silentwriter LC-890, and the Texas Instruments Omni-Laser 2115, which can scale a set of built-in typeface outlines to any point size between 1 and 255. Printers that lack page description languages, like PostScript, but that can accept downloadable fonts, such as the HP LaserJet and compatibles, have to use ready-made bit-mapped fonts.

FONTS CARTRIDGES The bit maps for a printer's internal fonts reside in the printer's ROM. In the LaserJet's infancy, users could supplement these internal fonts in only two ways. The easiest alternative

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THE PROBLEM WITH POSTSCRIPT EMULATION: SOFTWARE, NOT HARDWARE, HANDSHAKING

Using your laser printer's PostScript emulation is really no problem —just change the handshaking protocol from software control to hardware control.

Once available only to Apple Macintosh and LaserWriter users, PostScript, the premier page composition language from Adobe Systems, is currently a hot emulation option in the PC laser printer market. In fact, 6 of the 35 laser printers reviewed in this issue offer PostScript emulation: the NEC Silentwriter LC-890, an Editor's Choice; the QMS PS-800 Plus; The Laser Connection PS Jet; the Texas Instruments OmniLaser 2108 and OmniLaser 2115; and the Varityper VT-600.

Access to PostScript has brightened the dreams of would-be PC desktop publishers. With the introduction of the first version of PostScript for the PC, they eagerly connected Apple LaserWriters and PC laser printers that emulate the LaserWriter to their microcomputers. Visions of typefaces and page layouts danced in their heads.

But those who tried using PostScript without being able to make an essential change in the handshaking protocol found their dreams darkened again.

Since the Apple Macintosh expects applications software to monitor and control printing, it primarily supports the XON/XOFF software-handshaking protocol at its serial port. But the IBM PC prefers to do its own monitoring; it controls printing through DOS, across the DTR (data terminal ready) serial line, letting the software go its own way. As a result, early versions of PostScript, which used the XON/XOFF protocol exclusively, gave users more nightmares than pleasant dreams of page composition come to life.

PC software developers watched in chagrin as, after three or four perfect PostScript-composed pages emerged from their printers, scrambled pages of seemingly random composition followed. Having reached their buffer limits, the printers would send the requisite software pause-control code to the computers. Unfortunately, the PCs, unaccustomed as they were to the printers' language, understood only the firm grip of hardware handshaking and ignored the softly spoken software pause request.

Other users, trying to sidestep PostScript and handle routine printing tasks with their laser printers' Diablo 630 emulation mode, also were rudely awakened when, after a few pages were properly printed, they saw random lines, characters, and form-feeds interrupt their documents. They had failed to realize that PostScript-emulating printers run all their emulation modes through PostScript, using standard PostScript printing parameters.

Adobe Systems responded to these problems with the April 1986 version of PostScript. Users can now program all versions of PostScript released after April 1986 to use hardware handshaking as well as the default XON/XOFF software-handshaking protocol. The only remaining stumbling block is that the documentation that users need to make the change from software to hardware handshaking is still not readily available.

The Laser Connection, alone among printer manufacturers in addressing this problem in its documentation, solved it for users of its PS Jet and PS Jet Plus: it supplies a utilities disk with PS Jet and PS Jet Plus printers and controller boards that will, among other things, change the handshaking protocol for you.

DO IT YOURSELF But if you're not lucky enough to have The Laser Connection's help, there's still a way to make your PostScript printer work *mano a mano* with your PC, as well as change the bit-per-second rate for blinding speed. Here's what you need to know and do.

Most PostScript printers are configured to run in PostScript batch mode. Essentially, your printer communicates with your PC by accepting PostScript programming instructions in blocks of code, which the software you're running usually initiates. Standard printing parameters for PostScript batch mode, stored in a parameter file in PostScript called sccbatch, are 9,600 bps, XON/XOFF protocol.

To reprogram sccbatch, you'll first want to find the switch or the thumbwheel on your printer that you use to set the emulation mode. Make sure the mode is set to "interactive," the complement of the printer's batch mode. (Although the Apple LaserWriter calls this mode *1200*, the QMS and The Laser Connection printers typically refer to it as *interactive*.) The communications parameters for interactive mode are 1,200 bps, no parity, 8 data bits, 1 stop bit.

You can choose either of two approaches—using BASIC or a telecommunications program—to change the handshaking protocol.

IT'S BASIC Whichever approach you use, you'll need to set up your PC's COM port first. Make sure the DOS program MODE.COM is in the current directory or can be found through a PATH statement. Then issue the appropriate commands:

```
mode com1:1200,n,8,1,p
mode lpt1:=com1:
```

(You can substitute any valid COM or LPT assignment, depending on which PC port you're actually using for the printer.)

Next, enter BASIC and type the following program:

```
100 lprint "serverdict begin 0 exitserver"
110 lprint "statusdict begin"
120 lprint "25 9600 4 setsccbatch"
130 lprint "end"
140 lprint chr$(4)
```

In line 100 the 0 is a zero, the default password into the LaserWriter's operations. (If you've changed the password, be sure to substitute the change for the zero in this line.) The 25 in line 120 refers to the 25-pin port; 9,600 is the bps rate (which you can set as high as 19,200); and 4 is the code for DTR, parity ignore, handshaking. The chr$(4) in line 140 is the same as Ctrl-D.

These changes affect the batch mode only. The interactive modes (including all emulations) remain untouched. To change the interactive parameters, use "setsccinteractive" in place of "setsccbatch" in line 120.

TELECOMMUNICATE The other approach to changing the handshaking protocol is to treat your printer like a modem and run a telecommunications program on your PC.

Set up the correct communications parameters (1200,n,8,1,p, as above) and go on-line. Then type the word *executive* in lowercase letters; it's the log-on command for PostScript's interactive mode.

You'll soon see the PostScript sign-on message, which includes the current version. At the PS> prompt, type

```
serverdict begin 0 exitserver
statusdict begin
23 9600 4 setsccbatch
end
Ctrl-D
```

If your telecommunications program won't allow you to enter Ctrl-D, wait 30 seconds before you do anything else. That typical default time-out period tells PostScript that you're done and that it can begin processing the commands.

(Don't be alarmed when you see a warning after you enter *statusdict begin*; it means that you're making changes to the printer's parameter file.)

Next, turn the printer off and then on again. At start-up, a LaserWriter will print out a status page that includes a small mark at the baseline of its graphic image, indicating that DTR is set. Most other PostScript printers will simply list DTR among the parameters on their start-up, or status, pages.

The only printer we encountered any problems with when using this procedure was the QMS PS-800 Plus. The printer came with "parity ignore" active, which seemed to make no difference when running PostScript. It also had an HP LaserJet Plus emulation mode, but whenever we sent a page of graphics to the printer in that emulation mode, the results showed vertical white stripes running through each image.

The culprit was the parity-ignore parameter. By ignoring the parity bit of the data it was receiving, the printer was ignoring the eighth data bit as well. But this data bit is valid in graphics transmission—hence the white stripes through the images.

The solution was to reprogram sccinteractive with a value of 7, not 4. A value of 7 sets *no parity* (subtly but vitally different from *ignore parity*) and DTR flow control. (See the other possible reprogramming values listed below.)

CAUTION When you change the handshaking protocol, you're permanently writing it to the printer's EEROM (electrically erasable read only memory). Since EEROMs have a limited erase/write life (approximately 40,000 changes), you won't want to switch between DTR and XON/XOFF protocols too frequently.

So if you're using PostScript-capable software, leave XON/XOFF alone for sccbatch mode. Instead, change sccinteractive emulations to use DTR for your software and raise the bps rate. Here's a list of possible reprogramming values.

0 Ignore parity: The printer ignores the high-order bit of each 8-bit character it receives; the high-order bit of each character transmitted is zero. XON/XOFF flow control is used.
1 Odd parity: The printer checks the high-order bit of each 8-bit character it receives for odd parity; each character transmitted has odd parity. XON/XOFF flow control is used.
2 Even parity: The printer checks the high-order bit of each 8-bit character it receives for even parity. XON/XOFF flow control is used.
3 No parity: The printer treats all 8 bits of each character it receives as data and performs no parity checking. XON/XOFF flow control is used.
4 Ignore parity: DTR flow control is used.
5 Odd parity: DTR flow control is used.
6 Even parity: DTR flow control is used.
7 No parity: DTR flow control is used.

—Bill O'Brien

Bill O'Brien is a PC Labs project leader.

■ SOFT FONTS

was, and still is, to use a font cartridge, which adds additional bit maps to the printer's memory. Installing a cartridge is as easy as inserting a cartridge into an 8-track tape player. And the chances are good that your word processor will include cartridge-font printer drivers, which allow you to select fonts using your program's own commands.

On the downside, font cartridges usually provide a very limited range of fonts. A font is a single size of a typeface in a given style, such as 10-point Courier Bold, similar in concept to the single font available on the print wheel of a daisy wheel printer. To create near-typeset-quality output, you would want access to a full typeface family, which typically includes 30 or more fonts ranging from very small fonts for captions and footnotes to medium-sized fonts for body text to large fonts for headlines. The typeface family would also contain different styles, such as bold and italic, to use for emphasis and, perhaps, for headings.

But a typical font cartridge doesn't go very far in providing this variety. For example, HP's "F" cartridge, which costs $250, offers only four Times Roman fonts in medium text sizes and one Helvetica font in a headline size. You get a little more variety with the "Z" cartridge, which includes one Line Printer, eight Times Roman, and eight Helvetica fonts, but even these fonts are limited to small and medium point sizes (8 to 14 points).

Another drawback to cartridges is their lack of typeface variety. Almost without exception, you have to turn to your printer manufacturer for compatible font cartridges. And if you look to HP as an example, the cartridge library offers few choices. To adapt the words of Henry Ford, you can get any proportional typeface you want—as long as it's Times Roman or Helvetica.

Users of the original LaserJet who wanted more typographic variety could use a graphics-based formatting program like SoftCraft's *Fancy Font* ($180), which uses the printer's graphics mode to send a picture of each character to the printer. Unfortunately, this process is painfully slow because the formatting program sends information to the printer dot by dot, instead of relying on bit maps that are already stored in ROM.

The HP LaserJet Plus and the LaserJet Series II offer you another way of producing a variety of typefaces. With more RAM (512K bytes, expandable to 4.5 megabytes) than the original LaserJet, these printers can temporarily store disk-based bit-mapped fonts and use them as if they were stored in ROM. These downloadable, or soft, fonts offer the printing speed of ROM-based bit maps, along with much greater variety. Until it is deleted, however, each downloaded font occupies a por-

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tion of RAM that can't be used for anything else, so it's necessary to limit your bit-map library to only those often-used fonts. Because of the emergence of the LaserJet Plus as an emulation standard, the HP soft-font format has become an industry standard. Most of this discussion will focus on HP printers, but much of the information is applicable to other laser printers as well.

You can buy bit-mapped fonts in a preselected range of sizes, usually as part of a typeface family that includes regular, italic, bold, and perhaps bold italic styles. Unlike font cartridges, these soft-font packages, which usually cost about $200, offer sufficient variety for serious desktop publishers, letting you choose from a vast library of classic and specialty typefaces. Font-generation programs offer still more flexibility. Among this group are Bitstream's *Fontware*, Softcraft's licensed version of *Fontware*, and SWFTE International's *Glyphix*, which use compact typeface outlines to produce bit-mapped fonts in a wide variety of sizes, as needed.

Along with their advantages, downloadable fonts have their dark side. Because every font must have its own bit map, the font files can consume large amounts of disk space, easily eating up as much as 2 megabytes if regular , italic, and bold styles and a range of point sizes of various typefaces are loaded at the same time. Also, since the fonts reside in RAM, they must be reloaded every time you turn on the printer, and they involve the use of specialized software. Finally, your applications software has to know how to invoke the fonts. Applications programs vary widely in their ability to use cartridge and downloadable fonts, and each font vendor takes a slightly different approach to the difficulties involved in soft-font use.

Hewlett-Packard, the leading vendor of HP-format soft fonts, offers top-quality soft fonts with some mediocre downloading aids. HP sells its fonts under two different labels. The HP-label soft fonts include many of the same typefaces available in cartridge form. HP also sells, markets, and supports a line of soft fonts created by Bitstream. Distributed under the Bitstream label, this group of four packages includes three classic typeface families—Garamond, Century Schoolbook, and Zapf Humanist—as well as an assortment of decorative headline typefaces. HP leaves it up to the applications software vendors to provide printer drivers for its soft-font offerings. However, since software support for HP's soft fonts .is widespread, this is rarely a problem.

The accompanying downloading software is the weak point of HP's offerings. The *PCLPak* printer utility, which comes with some of HP's soft-font packages, can download fonts one at a time, or it can automatically download a group of fonts as

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part of a batch file. Unfortunately, its batch-file mode wastes a lot of disk space because you have to combine all of the desired font files together in a huge setup file. So, if you have several different setup files for different applications, you would need several copies of the same font file on your disk. The downloading utility that comes with HP's *Bitstream Soft Fonts* can only download fonts one by one. There is no provision for automatic batch-file operation.

HP has a new downloading utility in the works that will solve these problems. I looked at a prerelease version of this as-yet-unnamed program, which is slated to be bundled with new HP soft-font products. It offers simple menus for selecting soft-font files and provides a batch-file mode that doesn't waste space by requiring that you duplicate your font files.

DOWNLOADING MADE EASY But you don't have to wait for this new program. If you need to download the same set of fonts day after day, a simple BASIC program can automate the job. SENDFONT.BAS, the BASIC program printed here, can serve as your model. The author, Walt Sledzieski, is the LaserJet Customer Assistance Manager for the Boise (Idaho) Division of Hewlett-Packard Co.

For each font to be downloaded to the printer, you must perform three steps. First, you have to assign an identification number to the font. This number, which can be any number from 0 to 32767, will allow your applications program to invoke a particular font later on. The command sequence that assigns this ID number is ESC*#D, where # represents the ID number, and ESC represents the escape character (ASCII 27). This step corresponds to statements 20 and 60 in SENDFONT.

(LaserJet Series II users, take note. This ID number is for software control only and may not work when you select fonts using the control panel. For control-panel operation, use the ID number that appears next to the printed font sample produced when you press the "Print Fonts" button.)

Second, you have to send the data in the soft-font file to the printer. For this, you use BASIC's SHELL statement, which allows you to load and execute a different program. In this case, you invoke the DOS COPY program to send the font file to the printer, as seen in statements 30 and 70. The COPY command takes the following form:

```
COPY/B FILENAME PRINTER-
DEVICE-NAME
```

The COPY program should be used with

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the "/B" parameter, which tells COPY to ignore any end-of-file (Ctrl-Z) characters and send the entire file to the printer. If your font file resides in a different directory, you can include the entire path name as part of the filename. The printer-device name is the name DOS uses for your printer port. Alternatives to LPT1 can be LPT2, COM1, or COM2.

The third and final step is to tell the LaserJet whether the font is permanent or temporary. A permanent font remains in the printer's memory until you specifically delete it, or until you turn the printer off. A temporary font is erased when the printer receives a reset (ESC"E") command. The command sequence to make the font permanent is ESC*c5F. SENDFONT issues that command to the printer in statements 50 and 90. If you wanted to make the fonts temporary, you could substitute the command ESC*c4F. You repeat these three steps for each font that you want to send to the printer.

```
5   REM RESET PRINTER
10  LPRINT CHR$(27);"E";
15  REM ASSIGN ID NUMBER 1
20  LPRINT CHR$(27);"*c1D";
25  REM COPY SOFT FONT FILE TO PRINTER
30  SHELL "COPY/B TR240BPN.USP LPT1:"
40  SHELL "EXIT"
45  REM MAKE FONT PERMANENT
50  LPRINT CHR$(27);"*c5F";
55  REM ASSIGN ID NUMBER 2
60  LPRINT CHR$(27);"*c2D";
65  REM COPY SOFT FONT FILE TO PRINTER
70  SHELL "COPY/B TR300BPN.USP LPT1:"
80  SHELL "EXIT"
90  LPRINT CHR$(27);"*c5F";
100 SYSTEM
```

ANY FONT YOU WANT Once the fonts reside in the printer, you can invoke them using the ID numbers you have assigned. Although the LaserJet command sequences are often horrendously long and complex, HP has provided a convenient shorthand command for selecting soft fonts. This command, which can be included in a printer setup string or embedded in a text file, takes the form ESC(#X, where # represents the ID number of the desired font. For instance, if you downloaded a 12-point Times Roman italic font and gave it the ID number 1, you could invoke the font by embedding the following printer command in your document: ESC(1X.

Although this technique will work with most software, it's not easy to use because you have to remember which ID numbers go with which fonts. Furthermore, since your word processor is unaware of what size font you are using, it will not be able to perform right-justification.

A better alternative is to use a word processor equipped with a printer driver designed to work with your cartridge or soft-font files. Such a printer driver allows you to invoke the fonts with your application's own commands, and it also includes a



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■ SOFT FONTS

character-size table, which permits the program to right-justify text printed with a proportional font.

The major word-processing software vendors are working hard to keep up with HP's soft-font offerings, so if your copy of your word processor doesn't include the drivers you need, try contacting the software vendor to see if printer drivers are available for the soft fonts you have chosen. Among the popular packages that support HP soft fonts are *Microsoft Word*, *WordPerfect*, *Windows Write*, *WordStar 2000* and with a little effort, *XyWrite III Plus*. If that approach doesn't work, you may still be able to get help from utility packages such as VS Software's *Laser Word Processor Tool Kit*, SoftCraft's *Laser Fonts*, and Polaris Software's *Font Control*, which can write soft-font printer drivers for popular word processors.

VS Software's *Laser Word Processor Tool Kit* ($150) contains two menu-driven programs that write printer drivers for *Microsoft Word* and for *WordPerfect*. You just select the font files you need, and the *Tool Kit* programs do the rest. With the resulting printer drivers, the word processors can select soft fonts with their own internal commands, and they can produce right-justified text. The *Tool Kit* also includes an interactive downloading program that loads fonts one at a time, and a batch program that downloads a prepared list of fonts. Of particular interest to users of the Bitstream soft-font packages that HP markets, which contain only portrait fonts, is a program that converts fonts from portrait to landscape format.

The *Tool Kit* is also available at no extra charge with the purchase of any VS Software font family. VS Software, based in Little Rock, Arkansas, sells high-quality fonts from a library of 34 typeface families, including many typeface designs licensed from leading typesetting houses. A typical VS Software font family package includes 44 fonts and retails for $169.95.

Less-expensive but slightly lower-quality soft fonts are available from SoftCraft of Madison, Wisconsin. Each disk in the SoftCraft Standard Series font library contains up to 25 fonts and sells for only $15. The catch here is that these low-cost fonts are encoded in SoftCraft's own proprietary soft-font format rather than the standard

Hewlett-Packard format. So, only SoftCraft's *Laser Fonts* ($180) knows how to load these fonts into your printer.

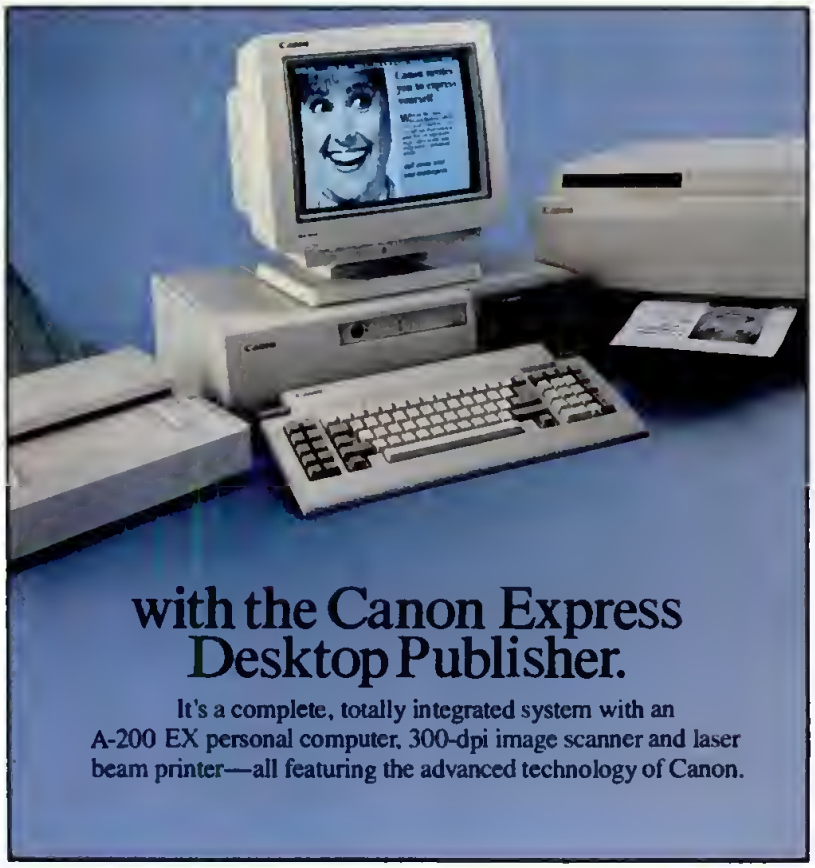
Laser Fonts includes a starter set of 34 soft fonts and a utility that can write printer drivers for *WordPerfect*, *Microsoft Word*, and *WordStar 2000* and create a font setup file for SoftCraft's own *Fancy Font* print formatter. *Laser Fonts* is not as easy to use as the VS *Tool Kit*, but you'll want to consider it if you want to create drivers that allow you to use cartridge fonts and soft fonts in the same document.

Another utility program in the same category is Polaris Software's *Font Control* ($99), which can download a preselected set of fonts and write printer drivers for *Microsoft Word* and *WordStar 2000*. *Font Control*'s printer drivers also let you use cartridge and soft fonts in the same document.

CREATING FONTS A different way to acquire soft fonts is by using a font-generation program. At the low end of this category is SWFTE International's *Glyphix* ($99.95), which can create and download a set of medium-quality fonts in just a few minutes, thus providing soft-font variety without forcing you to surrender large amounts of disk space for bit-mapped fonts.

Bitstream's *Fontware*, a more intelligent and more expensive font-generation system, is designed for those who want top quality along with flexibility and don't mind paying for it. The Fontware system, which is available from Bitstream and from OEMs, gives you access to Bitstream's *Fontware Library*, a collection of 20 different outline packages, including classic designs licensed from major typesetting houses.

The Bitstream version of the system includes a *Fontware Installation Kit* ($95) and typeface outline packages ($200 each). The system creates downloadable soft fonts and matching on-screen bit-mapped fonts in almost any size for either *Microsoft Windows* or *Ventura Publisher*, so that you see exact spacing and line endings on-screen. The system can also create fonts for a variety of dot matrix printers, and each outline package also includes a Bezier outline for use with PostScript-compatible printers.





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SoftCraft sells a similarly priced version of *Fontware* for word processing applications, which it licenses from Bitstream. The *SoftCraft Fontware Installation Program* ($95), together with a *Typefoundry Series Outline Package* ($195), produces laser printer fonts in HP and SoftCraft formats, as well as fonts for a variety of dot matrix printers. Like the Bitstream version, it offers a wide variety of sizes and character sets. The ability to choose character sets is important if you need special foreign-language or math characters.

The main drawback of the *Fontware* system is its slow speed. Unlike *Glyphix*, which can create fonts on the fly, *Fontware* takes its time. Because the program adjusts the shape of each character to match the resolution of the printer or screen, it can take between 3 and 15 minutes per font, depending on the size of the font. But if your schedule permits, you get unmatched flexibility and variety, along with high quality across the full range of font styles.

STORAGE SHORTAGE No matter what kind of soft font you choose, you'll need to deal with a number of storage issues. Because a bit-mapped font describes the location of each dot in each letter, font files can take up a lot of space, both on disk and in your printer's RAM. When you copy fonts to your hard disk, be sure to check if your applications program needs them in a particular directory. *Microsoft Word*, for instance, insists that the fonts reside in the directory that contains its printer drivers.

Before you send the bit-mapped fonts to the printer, you need to look at the sizes of the font files and determine if they will fit in your printer's RAM. The font-file size will vary, depending on the size of the font and on the number of characters in the font. For example, a font file storing 127 8-point (small-print) characters takes up about 6K, while a font file storing the same number of 30-point (headline-sized) characters takes up about 67K. In making this calculation, be aware that some of the printer's RAM is reserved for storing incoming print information. Thus, in a LaserJet Series II equipped with 512K bytes of RAM, only 395K is available for downloadable fonts. Be aware, too, that the printer's internal software will probably limit the number of fonts it can handle at once. The HP LaserJet Plus and Series II printers can deal with up to 32 soft fonts at a time, with a maximum of 16 fonts per page (although, of course, you should never use 16 fonts on a single page). These limits mean that you have to decide in advance which fonts you want to download.



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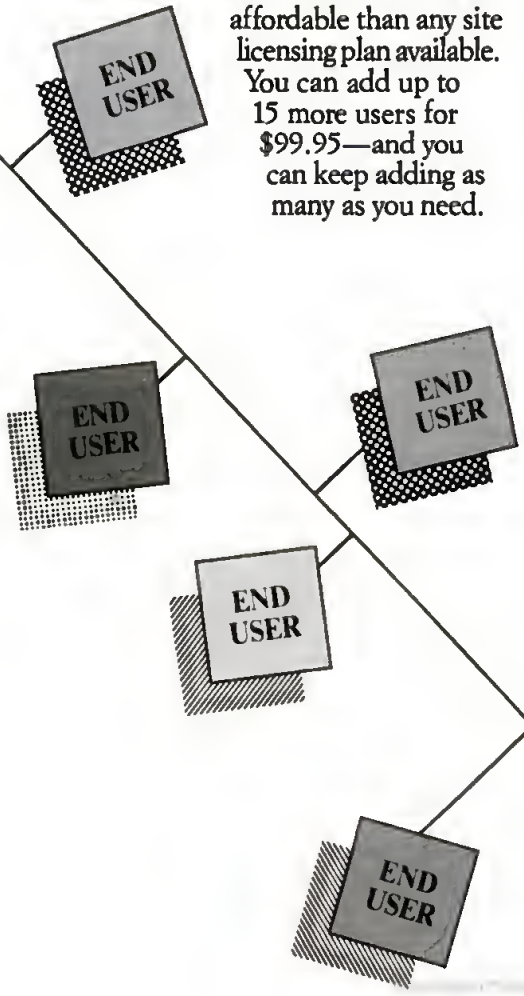
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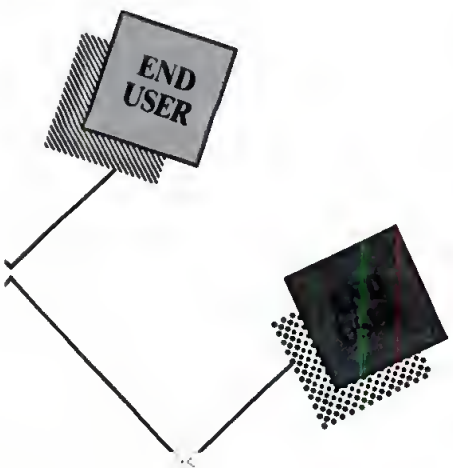
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This also requires extra coordination on a network, where users could easily erase each other's fonts or exceed the printer's memory limits.

To keep confusion to a minimum on a network, you might try giving each user a range of font identification numbers. These are arbitrary numbers assigned to each font as it is sent to the printer, which help the printer keep track of the downloaded fonts. Thus, one user might use numbers 1 through 10 for his fonts, while another uses numbers 11 through 20, and so on. While this approach keeps users from wiping out each other's fonts, it does not solve the printer memory problem. If a number of users on the network decide to download headline-sized fonts, they could easily exceed the memory limits of the printer.

Another approach, which takes a bit more coordination, is to agree on a network standard in which the same set of fonts, with an agreed set of ID numbers, is downloaded each day. Then everyone on the network knows that font number 1 is 12-point Times Roman regular, font number 2 is 12-point Times Roman italic, and so on.

Both of these solutions assume that the fonts will be designated as "permanent" when they are sent to the printer. Permanent soft fonts will reside in the printer's memory either until the printer is turned off, or until they are specifically deleted.

You can avoid most of these coordination issues if you use a word processing package that downloads the necessary fonts at print time and designates them as "temporary." The temporary fonts reside in the printer's RAM only until the printer receives a reset command, either through software or from the reset button. After each print job the fonts are cleared from memory, making room for the next set of fonts. Thus, one user can print a document using a set of Times Roman fonts, while the next user can print with a set of Helvetica fonts. Examples of software with this capability are *Microsoft Word*, *Microsoft Windows*, and *Ventura Publisher*.

Your choice of word processor can also make a big difference in the ease with which you can use different sizes of fonts in your documents. Even when you acquire the appropriate printer driver, you may find that your word processor's formatting commands, which worked fine with monospace fonts, are no longer adequate when you try to use them with proportional fonts of varying sizes. For example, *WordPerfect* requires you to change the margin and pitch settings every time you change fonts. If the new font is significantly larger, you'll also have to change the line-space setting.



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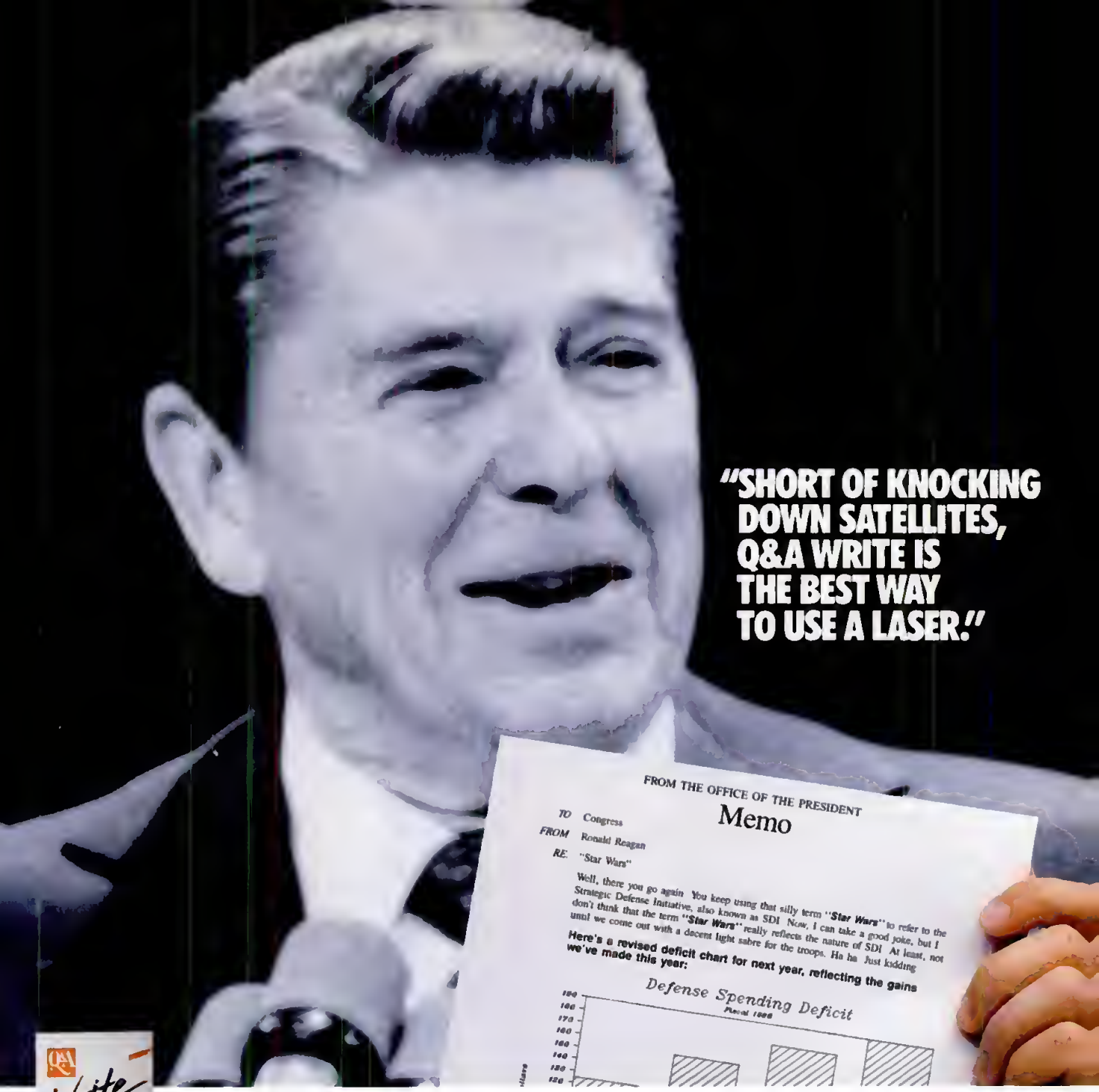
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PITCH IS THE HITCH Aside from the hassle involved in remembering to change all of these settings, there is another problem with this approach. The pitch setting, or the number of characters per inch, is not a very accurate measurement of font size because it ignores the vertical dimension, which typesetters measure in points (1/72 inch). Moreover, it doesn't make much sense to talk about pitch for a proportional font, because the number of characters per inch can vary. But *WordPerfect* needs that pitch setting, even for proportional fonts, to get appropriate spacing between words and to perform right justification. A quick way to determine the pitch setting for a proportional font is to count the characters in 3 inches of type, then divide by three. You then tell *WordPerfect* that your font is proportional by including an asterisk next to the pitch setting. If this pitch setting produces too much white space between words, increase the pitch setting and try again until you get satisfactory results.

■ If you use a macro utility, you can store your pitch, margin, and line-space settings.

While these complications are considerable, there are a few ways to simplify matters. If your word processor supports command macros, or if you use a macro utility like *ProKey*, you can store and reuse your pitch, margin, and line-space settings.

You might also consider using a separate formatting program to select fonts and format your text, such as SWFTE International's *LaserWare* ($99.95) or Polaris Software's *Ram-Resident PrintMerge* ($149). To use these programs, you specify the fonts you want to use in a setup screen and then embed formatting codes in your document. For example, with *LaserWare* the command [:1] would tell the LaserJet to begin printing with the first font on the setup screen. These programs also include formatting commands that set margins and line spacing and perform right justification, and they can download a specified set of soft fonts.

Another alternative is to switch to a word processor that offers better font handling and more-appropriate formatting capabilities. For example, *Microsoft Word* provides menus that allow you to select a font by typeface name and size. Most other word processors require you to remember

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that font 1 is, say, 12-point Times Roman regular, font 2 is 14-point Times Roman italic, and so on. Formatting is easier because *Word* makes all of the necessary margin adjustments automatically when the font size changes. Another nice feature is *Word*'s ability to set line spacing in point increments. Thus, you have the same kind of control over your output that a typesetter does when he specifies that lines of 12-point type should be set 3 points apart. *Word* can also produce automatic line spacing, based on the size of the font, so you don't need to think about changing from single to double spacing when you use a larger font, although this option sets the lines a bit too close together for comfortable reading.

If your formatting needs are relatively modest, you might also consider using, or importing text into, Microsoft's *Windows Write*. Like *Word*, *Windows Write* offers menu-based font selection, and it automatically adjusts the page format when you change fonts. In addition, it provides the bonus of a what-you-see-is-what-you-get display. Furthermore, *Windows Write* produces a more visually pleasing automatic line spacing.

Windows Write is especially convenient to use with soft fonts because *Microsoft Windows* can automatically download the needed fonts, although it requires a bit of tinkering before it will work. If you have *Windows*, Release 1.04, you can find detailed instructions for installing your soft fonts in two files called HPREADME.TXT and SOFTFONT.INI on the supplemental printer disk. (Users of earlier versions of *Windows* must update to Release 1.04 to obtain the necessary soft font installation tools.) The process involves running the *Printer Font Metrics Creation Utility* program, which was created jointly by Microsoft and Aldus Corp. and is also distributed with Aldus's *PageMaker*. Then you have to make some changes to the *Windows* initialization file called WIN.INI. When you've completed the installation, *Windows* applications such as *Windows Write* and *PageMaker* are aware of your soft fonts and will provide access to the fonts in their menus. At print time, *Windows* will download the appropriate fonts as necessary.

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can improve the quality of your laser printer's output if you learn some of the fundamentals of typographic design. Michael Kleper, author of *The Illustrated Handbook of Desktop Publishing and Typesetting* (Tab Professional and Reference Books, 1987) and professor of graphic arts at Rochester Institute of Technology, suggests that users exercise restraint when selecting typefaces. "Beginners should be cautious of too much variety in typeface design," says Kleper. "People get very excited about the variety of typefaces available, but they usually do best when they keep it simple." Kleper advises that you stick to a single typeface family within a single document, especially if the document is a business letter. Because ornate typefaces can be hard to read when used in body text, Kleper suggests instead that you choose a simple text typeface in a medium weight, neither very bold nor very light. Take care when mixing a sans serif typeface with a serif typeface. "You see it done effectively all the time, but you have to know what you're doing," he notes. In addition, Kleper offers the following document design guidelines:

- The font for body text should be between 9 and 12 points in size, with larger sizes reserved for headings and titles.
- Spacing between words should not exceed the vertical size of the font, although a preferable measure would be one-third to one-fifth of the point size. For example, word spacing in a 10-point font should not exceed 10 points, but 2 or 3 points would create a more pleasing result.
- Leading, or the spacing between lines, should be about 20 percent of the point size. Thus, a good-looking line spacing for a 10-point font would be 2 points.
- Line length should be between 50 and 60 characters, or not greater than 20 to 25 picas for normal body type, or not greater than 2½ times the point size in picas. If you use a longer line length, the reader's eye may have trouble locating the beginning of the next line on the left margin.
- Avoid a right-justification system that inserts spaces (microjustifies) between letters of a word. Says Kleper, "If your word processor does microjustification between characters, disarm it."

Although these hints won't turn you into a professional designer, they can give you a head start when you begin the switch from letter-quality to near-typeset-quality printing. Given the current state of software support, it's not an easy transition to make, but it can be worth the effort if you want to wring top performance out of your printer. PC

Dara Pearlman is a free-lance writer and computer programmer based in Cupertino, California.



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CIRCLE 306 ON READER SERVICE CARD

Index to Printer Reviews (1984-1987)

In the 4-year history of the *PC Magazine* printer project, reviews of 393 printers have seen print. Of this large end veried group, 260 printers ere either still in production or ere still availeble through retailers (the latter group is denoted by the term "out of production"). This historicel index lists those 260 stalwarts—some of which have been around since 1984—along with originel and current pricing information, type of printer, highest tested speed based on the PC Labs benchmark tests, whether the printer was superseded by enother model, end when it was tirst reviewed. In 1984, 1985, and 1986, speeds for dot matrix end daisy wheel printers were based on the same speed test. Also, from 1986 on, leser printer speeds were measured in peges per minute (ppm) rether than characters per second (cps). For exemple, the speed equivalent to the 123-cps rating of the Hewlett-Packard LaserJet turns out to be 7.4 ppm. In general, speeds of new dot matrix and daisy wheel printers ere epproximetely 7 percent higher than those of previous years. For extensive descriptions of the 106 new printers included here, see the reviews thet precede this index.

Company	Product	Type	Speed	Replaced by	Originel price	Current price	Vol.	No.	Pg.	Reader service number
Advanced Matrix	AMT Office Printer	DM	111 cps	AMT 250 Office Printer	$2,200	$1,845	3	23	359	
Advanced Matrix	AMT 250 Office Printer	DM (C)	160 cps		$1,845	$1,845	6	19	252	623
Alpe	ALQ200	DM	123 cps		$695	$695	6	19	249	602
Alpe	ALQ300	DM	123 cps		$995	$995	6	19	249	602
Alps	P2000	DM	138 cps		$995	$995	5	19	201	
Alps	P2100	DM	173 cps		$1,595	$1,595	5	19	224	
Alpe	P2400C	DM	170 cps		$1,395	$1,395	8	19	250	459
Apple	LaserWriter	L	108 cps		$6,995	$4,999	4	19	177	
Apple	LaserWriter Plue	L	8.0 ppm		$5,999	$5,799	5	19	298	
AST	TurboLaser	L	7.5 ppm		$4,995	$4,995	5	19	286	
AT&T	477	DM (C)	144 cps		$1,695	$1,695	5	19	232	
Axonix	ThinWrite 100	DM	60 cps		$479	$499	6	19	255	686
BDS	Laser 630/8	L	75 cps	Laser 630/8E	$3,495	$2,995	4	19	176	
Blaser	The Blaser	L	6.7 ppm		$2,795	$1,995	5	19	270	
Blaser	BleserStar	L	5.5 ppm		$2,395	$2,395	6	19	154	642
Brother	2024L	DM	71 cps	(out of production)	$1,295	$1,295	5	19	212	
Brother	HR-20	DW	21 cps		$499	$499	6	19	380	659
Brother	HR-40	DW	31 cps		$799	$799	6	19	380	681
Brother	M-1109	DM	53 cps		$299	$299	5	19	146	
Brother	M-1509	DM	78 cps		$549	$599	5	19	160	
Brother	M-1709	DM	127 cps		$699	$699	6	19	255	658
Brother	M-4018	DM	258 cps		$1,695	$1,695	6	19	260	625
Brother	Twinriter 5	DM/DW	77 cps	(out of production)	$1,295	$1,295	5	19	212	
Brother	Twinriter 6	DM/DW	99 cps		$1,395	$1,395	6	19	261	690
CAL-ABCO	Legend 1080	DM	49 cps		$339	$295	4	19	102	
CAL-ABCO	Legend 1385	DM	62 cps		$449	$395	4	19	105	
Canon	LBP-8ii	L	7.4 ppm		$2,500	$2,750	6	19	185	457
Canon	PJ-1080A	IJ (C)	23 cps		$795	$699	3	23	361	
Cardinel Technologies	DP2100	DM	51 cps		$299	$349	5	19	151	
CIE	LIPS 10 Plue	L	8.9 ppm		$2,995	$2,995	8	19	158	629
CIE	TriPrinter CI3500 Model 20	DM	247 cps		$1,995	$1,995	4	19	160	
CIE	TriPrinter CI3500 Model 20	DM	250 cps		$1,995	$1,995	6	19	262	688
Citizen	MSP-10	DM	86 cps		$449	$399	4	19	105	
Citizen	MSP-25	DM	93 cps		$849	$599	4	19	140	
Citizen	Tribute 224	DM	91 cps		$949	$949	6	19	264	667
Cordata	LP300 Desktop Printshop	L	5.9 ppm		$2,995	$2,195	5	19	274	
Cordata	LP300X	L	4.1 ppm		$3,895	$2,695	6	19	164	696
C. Itoh	8510SP	DM	86 cps		$795	$569	3	23	142	
C. Itoh	C-310 XP	DM	157 cps		$649	$699	5	19	174	
C. Itoh	C-315 XP	DM	150 cps		$819	$899	5	19	174	
C. Itoh	C-715A	DM	145 cps		$1,295	$1,295	6	19	267	691
C. Itoh	C-815	DM	195 cps		$1,995	$1,995	6	19	268	679
C. Itoh	Jet-Setter	L	4.9 ppm		$1,795	$1,795	6	19	162	601
C. Itoh	M-8510 SP	DM	66 cps		$549	$569	4	19	119	
C. Itoh	Printmaster F10-55	DW	45 cps	StarWriter F10-55	$1,995	$1,749	3	23	311	
C. Itoh	ProWriter C-310 CXP	DM	177 cps		$749	$749	6	19	270	652
C. Itoh	ProWriter jr. Plue	DM	72 cps		$369	$369	6	19	272	668

C—Color, DW—Daisy wheel, DM—Dot matrix, IJ—Ink jet, L—Laser, TT—Thermal Transfer

Company	Product	Type	Speed	Replaced by	Original price	Current price	Vol.	No.	Pg.	Reader service number
C. Itoh	StarWriter D10-40	DW	31 cps		$999	$1,049	5	19	330	
Daisy Systems	M20	DW	22 cps	(out of production)	$999	$495	3	23	278	
Daisy Systems	M45Q	DW	37 cps		$1,845	$1,495	3	23	313	
Data Technology	CrystalPrint VIII	L	6 ppm		$2,495	$2,495	6	19	168	644
DataProducts	8010/12	DM	82 cps		$649	$535	3	23	157	
DataProducts	8052	DM (C)	99 cps		$1,895	$1,599	3	23	370	
DataProducts	8070 Plus	DM	192 cps		$2,099	$2,099	5	19	247	
DataProducts	LZR 1230	L	10.9 ppm		$3,495	$3,495	6	19	167	847
Datasouth	DS 180	DM	128 cps		$1,595	$1,395	3	23	223	
Datasouth	DS 220	DM	150 cps		$1,995	$1,695	3	23	226	
Destiny	Laser Act I	L	5.6 ppm		$2,595	$2,595	6	19	177	627
Diablo	630 ECS	DW	38 cps		$2,295	$1,995	4	19	166	
Diablo	Advantage D25	DW	23 cps		$745	$895	4	19	136	
Diablo	Companion 34LQ	DM	138 cps		$1,599	$1,399	4	19	154	
Diablo	C-150	IJ (C)	14 cps	Xerox 4020	$1,250	$1,495	3	23	363	
Diconix	150	IJ	65 cps		$479	$479	5	19	158	
Digital Equipment Corp.	LA 210	DM	138 cps		$1,595	$1,595	3	23	213	
Digital Equipment Corp.	LN03	L	74 ppm		$3,495	$3,495	5	19	276	
Epson	EX-1000	DM (C)	119 cps		$995	$879	5	19	178	
Epson	EX-800	DM	115 cps		$749	$599	5	19	176	
Epson	FX-286E	DM	138 cps		$699	$699	6	19	272	550
Epson	FX-86E	DM	129 cps		$499	$499	6	19	272	550
Epson	GQ-3500	L	5.4 ppm		$2,199	$2,199	6	19	176	619
Epson	LQ-1000	DM	105 cps		$1,095	$999	5	19	185	
Epson	LQ-1050	DM	163 cps		$1,099	$1,099	6	19	275	626
Epson	LQ-2500	DM (C)	104 cps		$1,595	$1,498	5	19	226	
Epson	LQ-2500	DM	133 cps		$1,399	$1,399	6	19	276	621
Epson	LQ-800	DM	105 cps		$699	$599	5	19	185	
Epson	LQ-850	DM	153 cps		$699	$799	6	19	275	626
Epson	LX-800	DM	105 cps		$269	$269	6	19	283	463
Facit	B3100	DM	149 cps		$695	$695	6	19	284	687
Facit	B3150	DM	154 cps		$895	$895	6	19	284	687
Facit	B3350	DM	136 cps		$995	$995	6	19	286	666
Facit	D2000	DW	25 cps		$695	$795	5	19	319	
Florida Data	OSP 130	DM	314 cps	Model 130	$3,995	$3,995	3	23	243	
Fortis	DH45	DM/DW	76 cps		$1,295	$1,295	5	19	215	
Fortis	DM1310	DM	93 cps		$299	$299	6	19	288	635
Fortis	DM2010	DM	115 cps		$459	$459	5	19	156	
Fortis	DM2015	DM	102 cps		$599	$599	5	19	156	
Fortis	DX25	DW	22 cps		$645	$599	5	19	314	
Fortis	DX41	DW	31 cps		$799	$799	6	19	383	636
Fujitsu	DL2400	DM (C)	111 cps		$1,395	$1,395	5	19	220	
Fujitsu	DL2600	DM	170 cps		$1,495	$1,495	6	19	288	677
Fujitsu	DL3400	DM	143 cps		$995	$995	6	19	291	676
Fujitsu	DPL24	DM	126 cps		$1,995	$1,495	3	23	227	
Fujitsu	DX2200	DM (C)	105 cps		$645	$745	5	19	172	
Fujitsu	DX2300	DM	129 cps		$645	$645	6	19	292	676
Fujitsu	DX2400	DM	157 cps		$725	$845	6	19	292	676
Fujitsu	SP320	DW	41 cps		$1,499	$1,295	3	23	324	
Fujitsu	SP320E	DW	41 cps		$1,495	$1,495	5	19	338	
Genicom	1020	DM	111 cps		$899	$899	5	19	194	
Genicom	3210	DM	164 cps		$1,495	$1,495	5	19	222	
Genicom	3310	DM	143 cps		$1,995	$1,995	4	19	161	
Genicom	3310/Color	DM (C)	150 cps		$2,450	$2,295	5	19	252	
Genicom	3320 Quiet	DM	144 cps		$2,395	$2,395	4	19	166	
Genicom	3410	DM	230 cps		$2,450	$2,450	4	19	170	

C—Color, DW—Daisy wheel, DM—Dot matrix, IJ—Ink jet, L—Laser, TT—Thermal Transfer

Index to Printer Reviews (1984-1987) (continued)

Company	Product	Type	Speed	Replaced by	Original price	Current price	Vol.	No.	Pg.	Reader service number
Genicom	5010	L	6.5 ppm		$2,735	$3,495	6	19	182	464
Genicom Centronics	GLP	DM	29 cps		$314	$320	3	23	154	
Genicom Centronics	PagePrinter 6	L	7.5 ppm		$2,295	$2,495	6	19	179	456
Genicom Centronics	Printstation 220	DM	99 cps		$599	$599	6	19	297	665
Genicom Centronics	Printstation 240	DM	84 cps		$1,495	$1,249	4	19	152	
Genicom Centronics	Printstation 351 PC	DM	144 cps		$2,195	$1,850	4	19	164	
Hermee	615 Profess. Color Printer	DM (C)	96 cps		$2,595	$2,595	4	19	174	
Hermee	PC-4	DM (C)	173 cps		$2,350	$2,350	5	19	254	
Hermee	Personal Computer Printer I	DM	128 cps		$1,995	$1,995	4	19	161	
Honeywell	Bull 4/66	DM	235 cps		$2,400	$2,400	6	19	302	653
HP	LaserJet	L	123 cps		$3,495	$3,495	3	23	394	
HP	LaserJet 500 Plus	L	7.4 ppm		$4,995	$4,495	5	19	288	
HP	LaserJet Series II	L	7.5 ppm		$2,495	$2,595	6	19	185	546
HP	PaintJet	IJ	78 cps		$1,395	$1,395	6	19	297	633
HP	ThinkJet	IJ	70 cps		$495	$495	3	23	172	
IBM	5216 Model A02	DW	45 cps		$3,680	$3,680	3	23	340	
IBM	Color Jetprinter	IJ (C)	19 cps		$745	$745	4	19	133	
IBM	Proprinter II	DM	129 cps		$549	$549	6	19	304	453
IBM	Proprinter XL	DM	119 cps		$799	$799	5	19	186	
IBM	Quietwriter III	TT	81 cps		$1,699	$1,699	6	19	312	456
IBM	Quietwriter Model 2	TT	28 cps		$1,595	$1,399	5	19	226	
IBM	Wheelprinter E	DW	18 cps		$899	$699	5	19	322	
IBM	Proprinter X24	DM	172 cps		$799	$799	8	19	307	454
Imagen	Innovator ImageStation	L	7.0 ppm		$7,200	$5,995	5	19	299	
Infoscribe	800	DM	108 cps		$1,895	$1,795	5	19	245	
Kyocera	F-1010	L	9.2 ppm		$3,695	$3,695	6	19	186	685
Kyocera	F-2010	L	8.8 ppm		$4,695	$4,695	6	19	188	684
Kyocera	F-3010	L	15.8 ppm		$8,395	$8,395	6	19	190	683
Laser Connection	Big Klee II	L	7.5 ppm		$4,495	$4,495	6	19	192	651
Laser Connection	PS Jet	L	6.3 ppm		$4,995	$4,995	6	19	194	693
Mannesmann Tally	290	DM	133 cps		$999	$1,199	5	19	208	
Mennesmann Telly	330	DM	190 cps		$1,799	$1,799	6	19	320	649
Mannesmann Tally	490	DM	247 cps		$2,199	$2,699	5	19	250	
Mannesmann Tally	85	DM	89 cps		$549	$499	5	19	164	
Mannesmann Telly	87	DM	113 cps		$599	$599	6	19	317	650
Mannesmann Telly	90	IJ	101 cps		$799	$799	6	19	317	461
Mennesmann Tally	910	L	9.0 ppm		$3,695	$3,695	6	19	197	645
MPI	Solution Series SX	DM	119 cps		$895	$795	4	19	142	
NEC	Pinwriter P5XL	DM (C)	123 cps		$1,895	$1,295	5	19	232	
NEC	Pinwriter P7	DM	111 cps		$995	$995	5	19	206	
NEC	Pinwriter P9XL	DM	157 cps		$1,795	$1,795	6	19	322	675
NEC	Silentwriter LC-650	L	7.6 ppm		$2,295	$2,295	6	19	198	455
NEC	Silentwriter LC-890	L	6.0 ppm		$4,795	$4,795	8	19	200	682
NEC	Spinwriter 3550	TT	30 cps		$2,290	$1,179	3	23	342	
NEC	Spinwriter 8850	DW	44 cps		$1,990	$1,695	4	19	157	
Nlesho	NP-2405	DM	143 cps		$1,295	$1,295	6	19	324	548
Nissho	NP-2410	DM	184 cps		$1,845	$1,745	5	19	238	
Nissho	NP-910	DM	150 cps		$1,595	$1,345	5	19	231	
Oasys	Jato Card	L	6.6 ppm		$1,395	$1,395	5	19	262	
Oasys	LaserPro 810-R	L	7.5 ppm		$4,995	$4,595	5	19	292	
Oasys	LaserPro Express	L	7.4 ppm		$1,895	$1,895	6	19	202	660
Oasys	LaserPro Expreee Series II	L	7.4 ppm		$2,295	$2,295	8	19	205	628
Oasys	LaserPro Silver Express	L	7.4 ppm		$2,995	$2,795	8	19	208	657
Okidata	Laserline 6	L	5.8 ppm		$1,995	$1,995	6	19	213	654
Okidata	Microline 182 (IBM version)	DM	80 cps		$299	$299	5	6	149	
Okidata	Microline 182 (Standard)	DM	80 cps		$299	$299	5	6	151	

C—Color, DW—Daisy wheel, DM—Dot matrix, IJ—Ink jet, L—Laser, TT—Thermal Transfer.

If you're looking for a company that knows there's more to connectivity than tying computers together...



. . . you should

Looking for long-term networking solutions for your company can lead you on a maddening search. While many vendors offer isolated pieces in the networking puzzle, what you need is a company that sees the big picture. A company that can make total computer connectivity a reality for your firm.

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hotline, Novell delivers fast, reliable network support. And Novell product education courses provide in-depth information to help you get the most performance from your network.

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CIRCLE 103 ON READER SERVICE CARD



OVER 15,000 DESKTOP PUBLISHERS MADE MICROTEK #1.

More sophisticated desktop publishers are using Microtek desktop scanners with their IBM-PCs and Macintoshs than any other. This was true in 1985, 1986, and is still true in 1987! Several independent surveys have verified this.* Over 15,000 have chosen Microtek manufactured scanners.

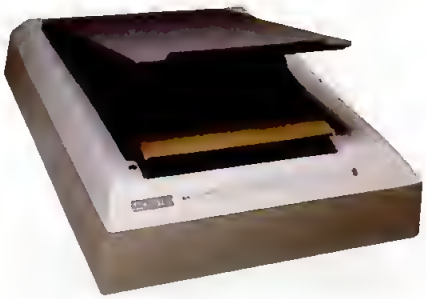
Why do more people choose Microtek? One reason is Microtek's product "family." You can choose from four different image scanners; plus Optical Character Readers; plus Fax communication tools; plus Raster to Vector conversion software.

*International Data Corp. and Dataquest reports.

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Our family gives you room to grow with the confidence that all members will work together.

Another reason why over 15,000 desktop publishers have made us #1 is that Microtek products are more reliable, and more feature-rich than others. You can count on receiving more capability for your money with Microtek. We are the choice of the serious user! Contact your local Microtek Dealer or call us to see why.



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CIRCLE 735 ON READER SERVICE CARD

Index to Printer Reviews (1984-1987) (continued)

Company	Product	Type	Speed	Replaced by	Original price	Current price	Vol.	No.	Pg.	Reader service number
Okidata	Microline 192	DM	105 cps		$499	$449	5	19	158	
Okidata	Microline 193 Plus	DM	105 cps		$749	$649	5	19	158	
Okidata	Microline 292 (Stand. & IBM)	DM (C)	132 cps		$699	$649	5	19	174	
Okidata	Microlins 293 (Stand. & IBM)	DM (C)	123 cps		$899	$849	5	19	174	
Okidata	Microline 294	DM	182 cps		$1,374	$1,199	5	19	216	
Okidata	Microline 393	DM	170 cps		$1,399	$1,399	6	19	326	674
Okidata	Okimate 20	TT (C)	26 cps		$268	$268	4	19	97	
Okidata	Pacemark 2410	DM	218 cps		$2,395	$2,395	4	19	168	
Olivetti	DM280	DM	82 cps		$595	$595	5	19	172	
Olivetti	DY450	DW	43 cps		$1,499	$1,499	5	19	340	
Olivetti	DY800	DW	55 cps		$1,699	$1,899	5	19	344	
Olympia	ESW 1000C	DW	13 cps		$549	$449	5	19	311	
Olympia	ESW 2000C	DW	22 cps		$799	$699	5	19	311	
Olympia	NP136	DM	141 cps		$649	$649	6	19	329	634
Olympia	NP30	DM	93 cps		$299	$299	6	19	329	669
Olympia	NP80	DM	142 cps		$499	$499	6	19	329	634
Output Technology Corp.	700e	DM	185 cps		$1,995	$1,995	5	19	245	
Output Technology Corp.	700n TriMatrix	DM	192 cps		$2,095	$2,095	5	19	246	
Output Technology Corp.	TriMatrix 850XL	DM	307 cps		$2,395	$2,395	6	19	330	630
Panasonic	KX-P1080I	DM	90 cps		$329	$259	6	19	332	632
Panasonic	KX-P1091I	DM	99 cps		$429	$269	6	19	336	689
Panasonic	KX-P1092I	DM	113 cps		$549	$499	6	19	336	545
Panasonic	KX-P1524	DM	116 cps		$899	$899	6	19	339	656
Panasonic	KX-P1592	DM	121 cps		$699	$649	6	19	342	638
Panasonic	KX-P1595	DM	138 cps		$949	$699	5	19	201	
Panasonic	KX-P3131	DW	17 cps		$419	$419	6	19	384	639
Panasonic	KX-P3151	DW	22 cps		$659	$659	4	19	126	
Personal Comp. Products	Laserimage 2000	L	7.5 ppm		$3,495	$3,995	5	19	262	
Personal Comp. Products	Laserimage 2000	L	7.6 ppm	Laserimage 2000 Plus	$3,995	$3,995	6	19	214	695
Personal Comp. Products	Laserimage 3000	L	7.3 ppm		$6,395	$6,395	6	19	216	624
Personal Micro Computers	DMP-85	DM	68 cps		$395	$295	3	23	160	
Personal Micro Computers	Electrical Typing Fingers	DW	7 cps		$395	$295	3	23	277	
Primages	Primage 90-GT	DW	56 cps		$1,295	$1,095	6	19	386	673
Printek	910	DM	144 cps		$1,595	$1,325	3	23	214	
Printek	920	DM	203 cps		$2,395	$1,895	3	23	253	
Printek	930	DM	111 cps		$1,995	$1,695	3	23	215	
Printek	FormsPro 2000	DM	111 cps		$2,195	$2,095	5	19	247	
Printronix	L1012	L	9.9 ppm		$3,495	$3,495	8	19	218	547
Printronix	P1013 Personal Line Printer	DM	99 cps		$795	$895	5	19	162	
Printronix	S-7024	DM	151 cps		$1,360	$1,360	6	19	394	641
Printware	720 IQ Laser Imager with 1200HD Image Processor	L	6.7 ppm		$12,980	$12,980	6	19	221	549
Qantex	7035	DM	123 cps	7075	$1,695	$1,795	3	23	216	
Qantex	7065	DM	192 cps	7085	$1,995	$2,395	3	23	216	
QMS	Kiss	L	7.4 ppm		$1,995	$1,995	5	19	268	
QMS	Lasergrafix 800	L	115 cps		$7,995	$6,495	4	19	180	
QMS	PS-800	L	5.2 ppm	PS-800 Plus	$5,699	$5,495	5	19	294	
QMS	PS-800 Plus	L	6.1 ppm		$5,495	$5,495	6	19	222	692
QMS	SmartWriter 80 Plus	L	7.5 ppm		$4,595	$4,595	6	19	223	694
Quadram	Quadlaser I	L	7.5 ppm		$3,795	$3,795	8	19	226	622
Qume	LaserTEN	L	8.8 ppm	LaserTENPlus	$2,795	$3,395	5	19	271	
Qume	LaserTENPlus	L	6.8 ppm		$3,395	$3,395	6	19	229	458
Qume	LetterPro Plus	DW	41 cps		$899	$799	5	19	328	
Qume	Sprint 11 Plus Widetrack	DW	38 cps		$2,990	$2,750	4	19	174	
Qume	Sprint 11/55 Plus	DW	54 cps		$2,295	$1,495	3	23	340	
Qume	Sprint 11/90 Plus	DW	63 cps		$2,500	$1,895	4	19	172	

C—Color, DW—Daisy wheel, DM—Dot matrix, IJ—Ink jet, L—Laser, TT—Thermal Transfer

Index to Printer Reviews (1984-1987)

Company	Product	Type	Speed	Replaced by	Original price	Current price	Vol.	No.	Pg.	Reader service number
RCA	VP2100	DM	51 cps	Cardinal Tech. DP 2100	$299	$349	5	19	151	
Ricoh	1500Q	DW	37 cps	3400Q 995	$1,489	$995	3	23	306	
Ricoh	PC Laser 6000	L	6.0 ppm		$2,395	$2,395	6	19	230	646
Sanyo	PR-241	DM	111 cps		$999	$999	6	19	346	640
Sanyo	PR-5500	DW	16 cps		$995	$399	3	23	287	
Seiko	DPU-40	TT	14 cps		$97	$115	3	23	155	
Seikosha	BP-5420AI	DM	216 cps		$1,849	$1,849	5	19	238	
Seikosha	MP-1300AI	DM (C)	119 cps		$799	$599	5	19	194	
Seikosha	MP-5300AI	DM	190 cps		$899	$799	6	19	346	672
Seikosha	SK-3000AI	DM	172 cps		$649	$699	6	19	349	671
Seikosha	SK-3005AI	DM	172 cps		$849	$899	6	19	349	671
Seikosha	SL-80AI	DM	60 cps		$549	$549	6	19	354	670
Seikosha	SP-1000	DM	51 cps		$299	$299	5	19	151	
Seikosha	SP-1200AI	DM	76 cps		$319	$319	6	19	358	631
Seikosha	SP-180AI	DM	51 cps		$249	$249	6	19	356	637
Silver-Reed	EXP-400	DW	12 cps	EXP-420	$399	$299	3	23	291	
Silver-Reed	EXP-500	DW	13 cps	EXP-600	$549	$699	3	23	279	
Silver-Reed	EXP-550	DW	19 cps	EXP-600	$649	$699	3	23	301	
Silver-Reed	EXP-770	DW	34 cps	EXP-800	$1,295	$949	3	23	317	
Star Micronics	Delta 15 PC	DM	76 cps	ND-15	$795	$649	3	23	148	
Star Micronics	Gemini 10X	DM	60 cps	NX-10	$399	$349	3	23	145	
Star Micronics	NB-15	DM	164 cps		$1,449	$1,399	5	19	222	
Star Micronics	NL-10	DM	72 cps		$379	$379	5	19	154	
Star Micronics	NX-10	DM	74 cps		$349	$349	5	19	154	
Star Micronics	SB-10	DM	74 cps	NB24-10	$749	$749	4	19	136	
Star Micronics	SD-15	DM	84 cps	ND-15	$599	$649	4	19	124	
Star Micronics	SG-15	DM	68 cps	NX-15	$499	$499	4	19	114	
Star Micronics	SR-15	DM	102 cps	NR-15	$799	$799	4	19	140	
Star Micronics	NB24-15	DM	125 cps		$1,099	$999	6	19	358	662
Star Micronics	NR-15	DM	151 cps		$799	$799	6	19	361	664
Star Micronics	NX-15	DM	84 cps		$499	$499	6	19	367	452
Tandy/Radio Shack	DMP-2110	DM	123 cps		$1,295	$1,295	5	19	216	
Tektronix	4696	IJ (C)	26 cps		$1,795	$1,795	6	19	367	462
Texas Instruments	850XL	DM	96 cps		$659	$599	3	23	166	
Texas Instruments	855	DM	102 cps		$935	$739	3	23	195	
Texas Instruments	855 Demand Docu. Printer	DM	195 cps		$2,295	$2,295	6	19	365	648
Texas Instruments	865	DM	96 cps		$999	$999	5	19	208	
Texas Instruments	880 AT	DM	172 cps		$2,295	$2,195	5	19	252	
Texas Instruments	OmniLaser 2015	L	7.1 ppm		$5,995	$5,995	5	19	296	
Texas Instruments	OmniLaser 2108	L	7.4 ppm		$5,995	$5,995	6	19	232	643
Texas Instruments	OmniLaser 2115	L	9.5 ppm		$7,995	$7,995	6	19	234	620
Toshiba	P321SL	DM	120 cps		$749	$749	6	19	370	460
Toshiba	P341SL	DM	125 cps		$999	$999	6	19	370	460
Toshiba	P351C	DM (C)	163 cps		$1,599	$1,599	6	19	368	661
Varityper	VT-600	L	5.6 ppm		$16,750	$16,750	6	19	237	655
Westrex	Westrex 1	DM	59 cps		$499	$199	4	19	116	
Xerox	4045 Laser CP	L	9.2 ppm		$4,995	$4,995	5	19	294	

C—Color, DW—Daisy wheel, DM—Dot matrix, IJ—Ink jet, L—Laser, TT—Thermal Transfer

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CIRCLE 293 ON READER SERVICE CARD

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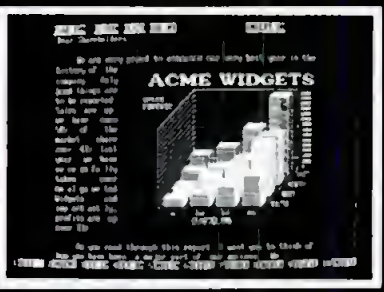


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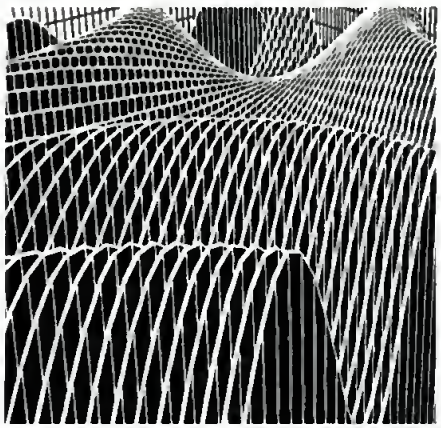
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CIRCLE 339 ON READER SERVICE CARD

2.0 ENABLE

Every now and then in the software industry something momentous comes along and changes attitudes overnight. The introduction of Enable 2.0 (with a LAN version, and now available on 3½" disks) promises to be one of those events.



Enable with Perspective.™ Talk about something to get excited about!

Perspective. *The* graphics package. As *Personal Computing* just wrote, "other products cannot even come close."

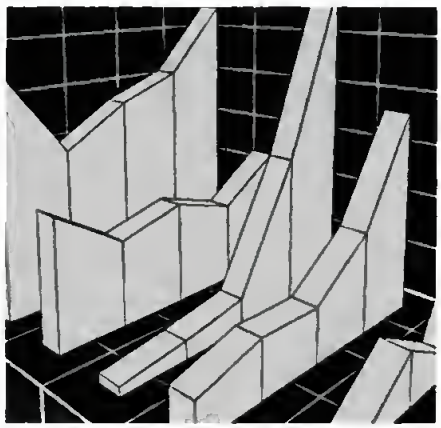
Now, Perspective is fully bundled in Enable 2.0. Which means you can now have an integrated system beyond all others. Word processing, spreadsheet, DBMS, communications and mind-boggling graphics all in one. All offering the power business users need (for confirmation, just read our "Raves" column to your right).

And what Perspective offers is truly awesome:

- 15 2-D and 32 3-D graphs from Enable's spreadsheet or database
- Menu exhibiting all graph types for selection
- Graphs can be resized, and rotated 360 degrees or on any axis for best viewing angle
- 180 choices of shades and patterns for various graph elements
- Automatically converts data from one 2-D chart to another, or from 2-D to 3-D; all graph types compatible.

Note: the six remarkable 3-D graphs you see on these two pages were drawn using Perspective. Which should give you greater perspective on Enable 2.0's vast potential.

Perspective ™ is a registered trademark of Three-D Graphics Inc



100+ new features and enhancements to enhance your productivity.

Not bells and whistles, but meaningful improvements! Across all modules. Brought about by listening to our special User Advisory Board, calls and letters to our Customer Support staff and continuing dialogue with such demanding Enable users as the U.S. Air Force, AT&T and Hughes Aircraft.

Here are some 2.0 enhancement highlights:

- A High-Level Language Interface [Basic, C, Pascal]
- Expanded macro facility
- Enhanced report language
- Enhanced menu generator
- Simplified installation/getting started procedure.
- 80,000 word Proximity/Merriam-Webster Linguibase™ spelling checker
- Row/column sorting on spreadsheets
- Simultaneous display and updating of spreadsheet and graph
- Enlarged Import/Export file compatibility with a wide range of popular software*

And remember, these are improvements to what is already recognized as the most fully featured, most powerful, most customizable, tightly integrated software system in existence.



More and more users are using more and more of Enable.

In the tough, spec-filled world of the Federal Government, Enable is by far the number one selling integrated software.

In the corporate world, after thorough testing and trial usage, dozens upon dozens of Fortune 1000 companies have specified Enable.

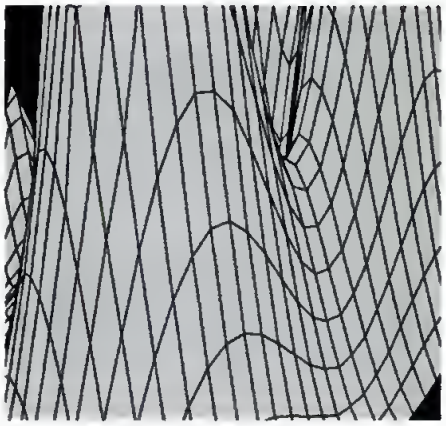
And thousands of smaller companies have come to the same conclusion: Enable has an incredible ability to handle a nearly unlimited range of jobs.

- From the Dow Corning Economic Evaluator, "It's not really a matter of finding ways to use Enable. I haven't found a way *not* to use Enable."
- From a DP Manager for Postal Service HQ, "When people come in for a spreadsheet, we give 'em Enable. Database... we give 'em Enable. Word processing... we give 'em Enable. I simply can't see us outgrowing Enable."
- From Xerox, after benchmarking the three leading integrated systems, "[Enable had] the user-friendliness and methodology of integration we were looking for."

As a complete off the shelf product or as a base product on which to build special applications, there just isn't a package on the market that can touch Enable. Especially now that 2.0 is here.

*Compatible with WordStar, MultiMate, EasyWriter, VolksWriter, PeachText, DCA, DIF, ASCII, 1-2-3, VisiCalc, SuperCalc 3, SYLK, dBASE, Condor 3, PC File III.

IN A NEW PERSPECTIVE



One after another, the raves keep flowing in.

Raves! Raves! Raves! Reviewers were lauding Enable even before 2.0.

"A masterpiece of engineering... Enable clearly outdistances its competitors. It is, without a doubt, the first of a new generation of integrated software products."

(PC Products)

"The great thing about Enable is that it gives you all the benefits of a collection of top-notch stand-alone packages—plus integration to boot. It's what Symphony was supposed to be."

(Software News)

"If you are looking for one program to do it all, this is the one."

(PC Magazine)

"Enable... may be the first program to make you give up your dog-eared WordStar, dBASE, Smartcom and Lotus 1-2-3 disks."

(Business Software)

"Each of the five modules... has a depth of features and functionality rare in an integrated package..."

(InfoWorld)

Enable 2.0 is bound to generate a whole new file of raves! Including your own.



Enable/LAN. A great new way to make connections.

Enable/LAN gives you the most useful, powerful PC network software on the market.

Consider, a system with all the benefits of Enable 2.0 itself:

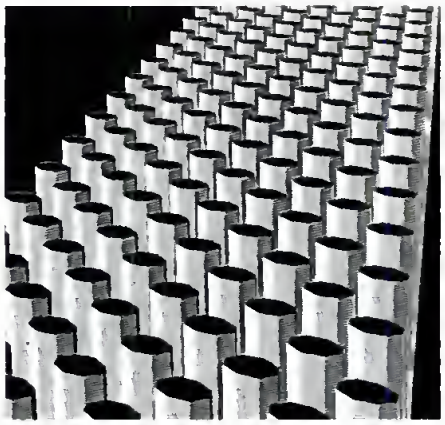
- System design, documentation and support making ease of use a reality.
- Word processing, spreadsheet, graphics, DBMS and communications equal to the functionality of the best stand-alones.
- Smooth, simple, fast integration between applications.

With all the LAN features you'd expect:

- Password protection for all applications.
- File and record locking for all applications.
- Compatibility with all the major networking software.

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PC MAGAZINE

HELP FILE

Volume 6
Number 19
November 10, 1987

DOS 3.3 Commands

APPEND *—Set data file PATH
SYNTAX: APPEND *d:path*[;[*d:*]*path*. . .]
—or—
APPEND [/X]]/E]
[*d:*][*path*] = path to search
/X = Search First, Find First and EXEC calls
/E = store APPEND path in environment

ASSIGN *—Give drive new name
SYNTAX: ASSIGN [*a*] = [*b*[. . .[[
a = drive to get new name
b = new name
Note: ASSIGN without parameters clears all assignments

ATTRIB * —Modify file attributes
SYNTAX: ATTRIB [+ R|− R[] + A|− A]][*d:*][*path*]*filename*[.*ext*] [/S]
+R = make read-only
−R = make not-read-only
+A = set archive bit
−A = reset archive bit
[*d:*][*path*]*filename*[.*ext*] = files(s) to change
/S = do all files in subdirectories also

BACKUP *—Back up files
SYNTAX: BACKUP *c:*[*path*[[*filename*[.*ext*]] *a:*]/S] [/M] [/A[
[/D:*mm-dd-yy*[[/T:*hh:mm:ss*[[/F] [/L[:[*d:*[[*path*]*logname*[.*ext*]]]

c: = drive for files to back up
[*path*] [*filename*[.*ext*]] = specific file(*s*)
a: = target drive
/S = do files in subdirectories also
/M = back up files changed since last BACKUP
/A = add files to backup disk
/D = back up files changed on or after date
/T = back up files changed on or after time on date
/F = format backup disk
/L = create a log file
[*d:*][*path*]*logname*[.*ext*] = drive/path and filename for log file

BREAK—Extend Ctrl-Break checking
SYNTAX: BREAK [ON/OFF]
ON = check during any DOS function
OFF = check only during I/O functions (default[
BREAK without parameters displays BREAK status

CHCP—Select code page for DOS
SYNTAX: CHCP]*nnn*]
nnn = number of desired code page

CHDIR (CD)—Change current directory
SYNTAX: CHDIR [*d:*][*path*[
d: = drive with path to change
path = new path
CHDIR without parameter displays current directory

CHDSK *—Check disk
SYNTAX: CHKOSK]*d:*][*path*[[*filename*[.*ext*]] [/F] [/V[
[*d:*] = drive to check
[*path*][*filename*[.*ext*]] = file(s) for fragmentation report
/F = fix errors
/V = show all files and paths

CLS—Clear the screen
SYNTAX: CLS

COMMAND—Start a secondary command processor
SYNTAX: COMMAND]*d:*] [*path*] [/P] [/C *string*] [/E:*xxxxx*]
[*d:*] [*path*] = drive/path for command processor to start
/P = make new processor permanent
/C = pass command string to new processor
string = any DOS command line
/E:*xxxxx* = set number of bytes for environment

COMP—Compare files
SYNTAX: COMP [*a:*] [*path*] [*filename*[.*ext*][[[*b:*][*path*[
[*filename*].*ext*]]
[*a:*][*path*][*filename*[.*ext*]] = primary file(s[
]*b:*][*path*][*filename*[.*ext*]] = secondary file(s)

COPY—Copy files
SYNTAX: COPY [/A[[/B[]*a:*[[*path*]*filename*[.*ext*]]/A] [/B[
[*b:*[[*path*[[*filename*].*ext*][[[/A[[/B[[/V[
—or—
COPY [/A] [/B[]*a:*[[*path*[*filename*].*ext*]]/A][/B[
] +]*a:*] [*path*[*filename*].*ext*] [/A[[/B[. . .]
]*b:*[[*path*][*filename*[.*ext*]] [/A] [/B[[/V]
/A = ASCII; stop at ^Z in source, add ^Z to target
/B = binary; ignore ^Z
[*a:*] [*path*]*filename*[.*ext*] = source file(s[
]*b:*] [*path*][*filename*[.*ext*]] = destination
/V = verify

CTTY—Change standard I/O
SYNTAX: CTTY *device name*
device name = AUX, COM1, COM2, COM3, COM4 to set new console; CON to restore to screen and keyboard

DATE—Set system date
SYNTAX: DATE]*mm-dd-yy*][*dd-mm-yy*][*yy-mm-dd*]
mm = month (1..12)
dd = day (1..31[
yy = year (80..99 or 1980..1999[

DEL = Delete file(s)
SYNTAX: DEL]*d:*] [*path*]*filename*[.*ext*]
]*d:*] [*path*]*filename*[.*ext*] = file(*s*[to delete

DIR—List files
SYNTAX: DIR [*d:*] [*path*][*filename*].*ext*[]]/P] [/W]
[*d:*] [*path*][*filename*[.*ext*[[= list which files
/P = pause when screen full
/W = Use wide format

DISKCOMP *—Compare entire diskettes
SYNTAX: DISKCOMP [*a:*]*b:*[[[/1] [/8]
a: = source drive
b: = target drive
/1 = only first side
/8 = only 8 sectors per track

DISKCOPY *—Copy entire diskette
SYNTAX: DISKCOPY [*a:*]*b:*][]/1]
a: = source drive
b: = target drive
/1 = only first side

ERASE *—Delete file(s)
SYNTAX: ERASE [*d:*[[*path*]*filename*[.*ext*[
[*d:*[[*path*[*filename*[.*ext*] = file(s) to delete

FASTOPEN *—Remember recent files and directories
SYNTAX: FASTOPEN *c:*] = *nnn*[. . .
c: = fixed disk drive
nnn = number of entries to remember for *c:*

FDISK *—Manipulate disk partitions
SYNTAX: FDISK

This *PC Magazine* Help File DOS Command Summary is the second in a series of handy pull-out reference cards we will publish periodically. Just tear it out and pin it on your wall.

The list below is based on DOS 3.3, and it contains some commands and syntax that differ from prior or non-IBM versions of DOS. Commands marked with an asterisk (*) are external programs. To run an external command on a hard disk system, it must either be in a directory listed on your PATH or you must specify the full path to it.

In future issues we'll publish more of the DOS command summaries and different Help Files that will assist you with other key areas of your system, as well as many of today's most popular software applications.

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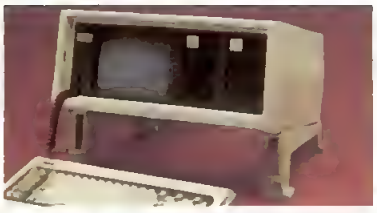
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■ PC LAB NOTES: UNDERSTANDING DOS ERRORS ■ ROBERT L. HUMMEL

INTERNAL ERROR HANDLING IN PC-DOS

How you can improve on the way DOS reports and handles errors, illustrating what Pope should have said: To err is human, to recover gracefully is the computer's task.

Veteran programmers are as likely to develop computer-assisted paranoia (CAP) as newcomers to DOS are. *Somebody* must be out to get me when a parity error in a single memory byte—probably a byte that's not even being used by my application—is enough to crash my PC and throw away everything I've done since my last save.

And the programmers who wrote the Power-On Self-Test (POST) built into the PC's hardware must surely have conspired to avoid coddling users with clear English error messages. If you hold down a key while your computer is booting up, instead of being told "A key is stuck," you get a cryptic "301" on the screen. Your wallet and authorized IBM dealer stand between you and your model's *Advanced Diagnostics* manual to learn what that means.

While these are uncommon faults, the error messages we get every day are no more enlightening. DOS's classic one-liner, "Abort, Retry, Ignore?", has been the inspiration for cartoons, premature aging, and this article. I worry when an operating system's best response to an error that may be as trivial as forgetting to close the diskette drive door or as serious as a hard disk crash is a multiple-choice question. The explanations for the causes, responses, and consequences of the device errors that trigger DOS's Critical Error response are buried deep in an appendix of the DOS manual, but by the time you can look them up the data on your screen has already been overwritten.

In addition to discussing DOS error handling in general, therefore, in this article I'll present a memory-resident interrupt handler for the Critical Interrupt, which I call SAFARI. An acronym for "Staying Away From Abort, Retry, Ignore," SAFARI prevents DOS from ruining on-screen data by saving the portion of the display that would be written over. In addition, it provides expanded error information and a postmortem of the stack to aid programmers.

PRODUCTIVITY INDEX

PC LAB NOTES
SAFARI saves on-screen data and makes error handling more helpful.
UTILITIES
CTYPE rescues the cursor after any program and shapes it up your way.
ENVIRONMENTS
Drafting old DOS programs to work under the OS/2 Kernel.
SPREADSHEET CLINIC
Helpful *1-2-3* messages about busy and out-of-sight spreadsheets.
USER-TO-USER
Freezing out warm reboots; temporary detours to your PATH.
POWER USER
Pointing *Word* to the right directory; transposing letters.
LANGUAGES
Redirecting Turbo Pascal I/O; rounded floating-points in BASIC.
PC TUTOR
Disk access alert; techie info source; easy key substitution.
CONNECTIVITY CLINIC
The network speed factor; new or old software for new networks.

YOUR COPY OF SAFARI The easiest way to get your own copy of SAFARI is to download it via modem from the PC Magazine Interactive Reader Service, as explained in the accompanying sidebar. If you prefer to enter the program yourself, both the assembly language listing and a BASIC program that will create SAFARI.COM when you run it once are printed here. SAFARI.ASM and SAFARI.BAS are also available from the PC-IRS.

Once you have a copy of SAFARI.COM, the best way to load it is by making the command the first line in your AUTOEXEC.BAT file. (Make sure, of course, either that the program itself is in your root directory or that you specify the full pathname so that DOS can find it.) This ensures that SAFARI will be the first program to load after DOS is initialized. SAFARI will hook itself into DOS and be completely invisible to all remaining programs.

From that point on, anytime a critical interrupt occurs, SAFARI will take over. A window will appear on the screen detailing the type of error that occurred and showing the contents of the CPU registers that caused the failed operation. Figure 1 shows an example of a SAFARI report caused by executing DIR A: with no disk in the drive.

After saving the screen contents under the window and displaying the registers and error information, SAFARI simply passes control to DOS, which generates

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■ PC LAB NOTES

```
<< SAFARI Critical Error Handler >>
 System Reports A Disk Error
 Drive Not Ready
 On Drive A:
 During A Read Dperation
 Error Localized In
 File Allocation Table

 AX=113F BX=40E2 CX=0000 DX=0055
 DS=9B79 SI=0000 ES=9B79 DI=0068
 CS:IP=9B79:112B


Not ready error reading drive A
Abort, Retry, Ignore?
```

Figure 1: *SAFARI message example (DOS 3.1).*

the response prompt. Select from Abort, Retry, Ignore. If a valid response is entered, SAFARI will restore the screen to its previous condition and your application will continue. (Note that DOS 3.3 modifies the prompt message. The Fail option is either substituted for Ignore or added to the list. Fail differs from Ignore in that the calling program is told that an error has occurred. Since there are more installations of pre-3.3 DOS, however, I'll stick to the common conventions here. If you're using 3.3, though, keep the substitution in mind.)

ERROR CATEGORIES Different types of errors require different responses. Applications program errors are mistakes made when working inside a program. These errors are detected and handled by the program. Examples include syntax errors in BASIC, a bad formula entry in a spreadsheet, or incorrect keystrokes in a word processor menu. Errors of this type are mostly minor and do not indicate anything is wrong with the application or PC.

Hardware errors usually indicate a serious problem with the computer that, if not corrected, will prevent further use of the PC. Most of these errors are detected during the POST (Power-On Self-Test) routines built into the BIOS and are displayed as error numbers on the screen. They are mainly concerned with devices. A device can be a disk drive, monitor, keyboard, or printer. IBM devotes over 100 pages in its DOS *Reference* manual to messages produced by DOS, many of which are device error messages. Let's look for a moment at device error causes and how they are reported and handled internal to DOS.

DEVICE ERROR CAUSES External errors, caused by a real, physical situation, are usually easy to explain and correct. Printing to a printer that's turned off or out of paper is a surefire way to generate a device error. Attempting to copy files to a diskette with a write-protect tab on or using a drive with an open door will also generate an error. In each case, however, you have an opportunity to correct the error and continue.

Internal errors, by contrast, are more problematic and are symptoms that the device is having trouble communicating with other hardware in the system or with its medium. Asking a disk drive to read or write to an unformatted disk creates a conflict that the disk controller simply cannot resolve. It then reports an error and waits for new instructions.

DETECTION AND REPORTING Device errors usually occur and are detected on a low level, either by the BIOS or by the device itself. If detecting the error is to serve any purpose, it must be reported to the program that requested the operation. The method of error reporting must be agreed upon and followed by the requesting program and the responding program in order for it to be understood.

■ Device errors usually occur and are detected on a low level, either by the BIOS or by the device itself.

Some devices, such as the disk controller, have the ability to correct certain errors internally. If successful, the operation proceeds normally and no error is reported. Otherwise, information about the error is reported to DOS according to a standardized procedure. How DOS responds and passes the information to our programs varies with the type of function that caused the error. These functions fall into two groups. The first comprises all functions



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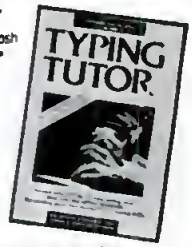
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■ PC LAB NOTES

invoked under interrupt 21h, and the second, all other DOS interrupts. Since error reporting for DOS interrupts other than 21h is simpler, we'll discuss these errors first.

DOS INTERRUPTS DOS interrupt 25H (Absolute Disk Read) and 26H (Absolute Disk Write) transfer control directly to the program (called the device driver) that controls the disk. If anything goes wrong while performing the read or write operation, the error is reported in the following way:

1. The carry flag (CF) is set to 1 in the flag register. (DEBUG shows this as 'CY'. CF=0 is shown as 'NC'.)

2. The AH and AL registers contain the error codes as shown in Figure 2.

The use of the carry flag to signal that an error has occurred gives you a convenient way to control the flow of your programs. By testing the CF immediately after the interrupt, you can detect an error and take corrective action. Figure 3 shows a simple program you can assemble with DEBUG to generate disk errors. You don't need to type the comments, and be sure to enter a blank line where shown. Try executing the program with the drive door open, and then again with a scratch diskette in the drive. Note the status of the CF after the interrupts and the contents of AX. Decode the error by comparing the value of AL with those listed in Figure 2.

■ The use of the carry flag to signal that an error has occurred gives you a convenient way to control the flow of your programs.

INTERRUPT 21H SUBFUNCTIONS The DOS interrupt 21h subfunctions do not report errors as consistently or simply as do the other DOS interrupts. The functions perform such a variety of tasks that expanded error reporting is required to explain everything that could go wrong. To preserve compatibility with previous versions, however, each new edition of DOS must continue to report errors in the same way as previous versions did; otherwise, programs written for older versions would not work. New functions, however, can take advantage of expanded error reporting. The result is that programmers must

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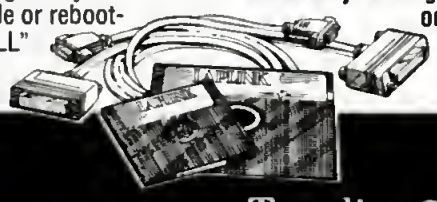
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```
Carry Flag (CF) is set to 1 (CY) to indicate an error.

The bits in AH are decoded as follows:

HEX       <-----AH------->        Meaning

80        1 0 0 0  0 0 0 0        Attachment failed to respond
40        0 1 0 0  0 0 0 0        SEEK operation failed
20        0 0 1 0  0 0 0 0        Controller Failure
10        0 0 0 1  0 0 0 0        Bad CRC on diskette read
04        0 0 0 0  0 1 0 0        Requested sector not found
03        0 0 0 0  0 0 1 1        Write attempt on write-protected diskette
02        0 0 0 0  0 0 1 0        Address mark not found
01        0 0 0 0  0 0 0 1        Invalid command
00        0 0 0 0  0 0 0 0        Error other than types listed above

AL contain the error code as follows:

          (AL)      Meaning
          ----      -------
          00h       Write-protected violation
          01h       Unknown drive number
          02h       Drive not ready
          03h       Unknown command (to controller)
          04h       CRC data error
          05h       Bad request structure length
          06h       Seek error
          07h       Unknown media (disk) type
          08h       Sector not found
          09h       Printer out of paper
          0Ah       Error while writing
          0Bh       Error while reading
          0Ch       General Failure
```

Figure 2: *Error reporting for Int 25h and 26h.*

```
DEBUG
-A 100
xxxx:0100 CLC                           ;turn the carry flag off (NC)
xxxx:0101 MOV AL,0                      ;choose drive A:
xxxx:0103 MOV BX,200                    ;destination for data read is ds:bx
xxxx:0106 MOV CX,1                      ;read one sector
xxxx:0109 MOV DX,FFFF                   ;a sector number which doesn't exist
xxxx:010C INT 25                        ;attempt to read, return with error
xxxx:010E NOP                           ;target for Go command
xxxx:010F                               ;blank line (hit ENTER)
-G 10E
          (note the CF is on, decode the error from AX)
          (insert diskette, close the door and rerun the program)
-RIP
IP 010E
:100                                    ;start execution at 100
-G 10E
          (again, the CF is on, error in AX should be different)
-Q
```

Figure 3: *Sample interactive session for producing Int 25h errors.*

do more work to find out if an error has occurred and what the appropriate corrective action is.

Functions that use the old File Control Block (FCB) method of file access return FFh in the AL register if an error occurs. This group of functions came in with Version 1.0 of DOS and includes functions 0Dh–24h and 27h–29h.

The File Handle function calls introduced with DOS 2.0 indicate an error by setting the carry flag to 1 and putting an error code in the AX register. The meanings for codes 1–12h are shown in the table "Meanings of File Handle Function Error Codes." Not all error codes are valid for every function, and some do not seem to be used. Moreover, for reasons clear only to IBM, trying to remove the current directory with function 3Ah returns error 5, Access Denied, not the error 10h you would expect.

EXTENDED ERROR REPORTING

Beginning with Version 3.0, the developers of DOS incorporated interrupt 21h subfunction 59h, Get Extended Error Information. This function is designed to provide a uniform and consistent set of error codes. In addition, it provides more information about the error and even suggests appropriate corrective actions.

To take advantage of this function, it should be issued immediately after an error occurs. On return, AX contains the extended error code, BH contains the error class (type), BL contains the recommended actions, and CH contains the "locus"

Meanings of File Handle Function Error Codes

AX	Meaning
01h	Invalid function number
02h	File not found
03h	Path not found
04h	Too many open files (no handles left)
05h	Access denied
06h	Invalid handle
07h	Memory control blocks destroyed
08h	Insufficient memory
09h	Invalid memory block address
0Ah	Invalid environment
0Bh	Invalid format
0Ch	Invalid access code
0Dh	Invalid data
0Eh	Reserved
0Fh	Invalid disk drive
10h	Attempt to remove the current directory
11h	Not the same device
12h	No more files

■ PC LAB NOTES

```
program fragment
.
.
.
ERROR:    MOV       AH,59H              ;Get extended error function
                    MOV BX,0            ;BX is the DOS Version (0 for 3.x)
                    INT 21H             ;Thru DOS
.
.
.

On return:          AX = Extended Error Code
                    BH = Error Type
                    BL = Recommended Action
                    CH = Affected Area
```

Figure 4: *Using function 59h (Extended Error) to get additional error information.*

(area) involved in the failure. The calling sequence is shown in Figure 4.

There is more to recommend the use of this function than simply its uniform method of reporting. As the DOS *Technical Reference* manual (Version 3.20, page 6–39) notes, "Programs written from now on are *expected* to use the extended error support both from interrupt 24h hard error handlers and after any interrupt 21h function calls." The emphasis is mine, but considering the leniency of other DOS suggestions, it comes as a fairly stern warning.

CRITICAL INTERRUPT HANDLER

While many of the subfunctions invoked under the DOS interrupt 21h umbrella can detect and report errors themselves, some use a different error response strategy. If an error occurs during the execution of these functions, DOS issues an interrupt 24h. This is known as the Critical Error Interrupt, and the program that receives control is called the Critical Error Handler (CEH).

Although the name "Critical Error Handler" may conjure up a vision of your PC catching fire, its use is really more mundane. The CEH must attempt to recover from a variety of internal and external errors that would generally prevent the application from continuing. There is a default CEH built into COMMAND.COM, and unless a currently executing program replaces it, it is in effect during our applications. If you have ever left a diskette drive door open and been greeted with "Abort, Retry, Ignore?", then you have seen the DOS CEH in action.

Before the Critical Error Handler is invoked, DOS retries the operation. This is done to give physical devices, such as the motor on a diskette drive, time to respond. The specific number of tries before an error is reported varies according to the version, but the intent is the same. Note that the CEH is not called for errors during interrupts 25h and 26h.

ABORT, RETRY, IGNORE, FAIL?

When DOS issues the "Abort, Retry, Ignore?" message, it is indicating that it detected an error while reading or writing to a device. The error message indicates what type of error was detected and which device was operating. The format for the error message is

```
<type> error [reading|writing] <device>
```

The error types are listed in the DOS *Reference* manual, along with explanations. This information is summarized in the table "DOS Device Error Messages and Recommended Responses." The classifications and recommended actions are unofficial (i.e., mine). What is both official and important is not to change diskettes while DOS is inside the CEH. (See the sidebar "Don't Change that Disk!")

When you enter R to retry an operation, the original function request that caused the error is reexecuted. The operation can be retried as many times as desired, but since DOS has already retried at least three times, it rarely succeeds. Go ahead anyway. Everyone always does.

Telling DOS to ignore the error is a form of gambling. If DOS feels the error is harmless, it will simply continue. The calling program will mistakenly think the operation has been performed successfully. This response can cause problems in an applications program. If the error is too serious to be ignored, it will abort the program. But it's better for you to make the choice than DOS.

DON'T CHANGE THAT DISK!

For experienced PC users, changing disks is almost a subconscious act. When we copy files, make backup copies, or run our favorite application, the disk swapping can become fast and furious. DOS handles disk changes so well, in fact, that we can become careless and forget that sometimes a disk change is not allowed.

When DOS is using a disk, it keeps a copy of the file allocation table (FAT) in memory. The FAT keeps track of what portions of the disk contain information for each file. As you add, modify, or delete files, DOS updates the FAT to reflect the most recent changes.

Each time DOS uses the disk in normal operation, it checks to see if the disk has been changed. If it has, the new FAT is read into memory and then the operation is performed. There is, however, an important exception to this rule. If the disk is changed in the middle of a DOS operation, no disk change will be detected. The most common occurrence of this is during a critical error, when DOS issues its infamous "Abort, Retry, Ignore" error message.

If you change disks when DOS is in this state, the FAT from the original disk will be written over the FAT that belongs to the newly-inserted disk. The result is complete garbage. The location of the original information on the new disk is lost. So, always abort and start over with the proper disk.

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■ PC LAB NOTES

DOS Device Error Messages and Recommended Responses

Internal Errors (Abort recommended)
- Bad call format
- Bad command
- Bad unit
- FCB unavailable
- Lock violation
- Seek

Diskette Problems (Abort and rerun with new diskette)
- General failure (unformatted diskette)
- Non-DOS disk
- Read fault
- Sector not found
- Write fault

Drive Problems (Close door and retry)
- Not ready

Other Problems
- No paper (add paper to printer or turn it on)
- Sharing violation (wait and try again)
- Write protect (remove tab or abort)

The Ignore problem was addressed in DOS 3.3, in which, for most cases, the Ignore option is replaced with the Fail option. This means that DOS will return to the calling program, indicating that the operation has failed. It's a better response than Ignore, because it lets the calling program detect the error using normal methods. Some operations, like writing to the printer, offer both the Ignore and Fail options. This allows a program to proceed despite a printer error.

Finally, there is the Abort option. This causes DOS to terminate the currently running application, reload COMMAND.COM (if it is required), and then reset itself to the ready state. Contrary to what is stated in the *Technical Reference* manual, this choice does not terminate the program by using the Ctrl-Break interrupt in DOS 3.1.

The internal CEH calls the Int 21h subfunction 4Ch (Terminate Process) with exit code AL=FFh. Either way, however, the program is terminated and control reverts to DOS.

INSIDE THE CEH Each time you start DOS, it establishes default handlers for interrupts 22h (Terminate Address), 23h (Ctrl-Break), and 24h (Critical Error). The routines are located in the resident portion of COMMAND.COM and produce the familiar "Abort, Retry, Ignore?" message in response to device problems. Many sophisticated programs, such as word processors, install their own handler for the Critical Error and suggest some action for you to perform to allow the application to continue.

But a program that gains control over interrupts 22h, 23h, and 24h can remove or defeat control of the PC by the operating system. To prevent this, DOS treats these three interrupts very differently from the others. When a program running under DOS terminates, the address vectors for these three interrupts are restored to point to their default handlers in COMMAND .COM. Programs that remain memory-resident and are able to intercept other interrupts still lose control of these three. Therefore, permanently resident routines can never be installed for these vectors. (What, never? Well, hardly ever, as you'll see shortly.)

The address of the DOS CEH is stored as a vector at location 0000:0090h in the form SEGMENT:OFFSET. The routine address cannot be found by examining the vector location with DEBUG, however, since DEBUG points the interrupt to itself! BASIC also resets the vector, so it can't be found with PEEK commands. However, the short program shown in Figure 5 will print out the location of the interrupt vector when you run it. It uses the DOS Get Interrupt Vector function to get the location and a short subroutine to print out the value (in hex). The location printed out will vary with the version of DOS in use and with your system configuration. Once you have the address of the default vector, you can use DEBUG to examine the routine inside COMMAND.COM.

CEH ERROR ENCODING When control is transferred to the CEH, the registers contain a variety of error codes and pointers. The codes are packed and must be decoded bit by bit to determine the cause of the error. The following steps should be used to interpret the registers

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■ PC LAB NOTES

1. If the high-order bit of AH is 0, then the error was caused by a disk operation and is known as a hard error. AL contains the failing drive number (0=A, 1=B, etc.). The remainder of AH is decoded as shown in the table "AH Error Codes." BP:SI points to the Device Header Control Block of the failing device. The lower byte of DI contains the error code.

2. If the high bit of AH is 1, then it was a nondisk device, like a printer, or a bad memory image of a disk FAT (file allocation table). If the high bit of the byte at BP:[SI+4] is 1, it is a block device and indicates the error was a bad FAT image. If the high bit of the byte at BP:[SI+4] is 0, then a character device was involved, AL contains no information, and the lower byte of DI contains the error code.

The error codes for the lower half of the DI register are the same as those shown for AL in Figure 2.

When the CEH is invoked, the stack in use belongs to the applications program that issued the original Int 21h request that caused the error. The table "Stack on Entry to CEH" shows the stack contents. The registers at the time of the Int 21h are preserved and accessible by stack addressing. They can be examined to see which DOS function was attempted when the error occurred. If the CEH issues an IRET (return from interrupt), DOS's response is determined by the contents of AL as follows:

```
AL = 0   Ignore the error
   = 1   Retry the operation
   = 2   Terminate the program (abort)
   = 3   Fail the system call that is in progress
```

The first three choices should sound familiar. The Fail option is used internally when DOS decides Ignore and Retry are not appropriate.

■ When a critical interrupt occurs, control of the PC is temporarily lost to the program.

HANDLING THE ERROR YOURSELF

When a critical interrupt occurs, control of the computer is temporarily lost to the applications program. Using the DOS "Print String Like a TTY" function, the CEH writes on the screen and waits for a reply. The status of the display is disrupted, information may be written over and lost, and the cursor position is moved. The application program has no knowledge of this disruption and so may not repair it. Avoiding this involves writing a CEH to



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CIRCLE 179 ON READER SERVICE CARD

■ PC LAB NOTES

```
M SHOWVECT.COM
A 100
MOV     AH,35     ;get interrupt vector in es & bx
MOV     AL,24     ;for Int 24h
INT     21        ; thru DOS
MOV     SI,BX     ;save offset in SI
MOV     AX,ES     ;put segment in AX
CALL    0119      ;write to screen
MOV     AH,02     ;write a
MOV     DL,3A     ; ':' char
INT     21        ; thru DOS
MOV     AX,SI     ;put offset in AX
CALL    0119      ;write to screen
RET               ;near return to DOS
MOV     BX,AX     ;HEX4PRN - write AX to screen
MOV     CL,04     ;use for shift count
MOV     CH,04     ;number of digits to print
ROL     BX,CL     ;print high digit first
MOV     AL,BL
AND     AL,0F     ;lower 4 bits only
ADD     AL,90     ;convert AL to ASCII
DAA
ADC     AL,40
DAA
MOV     DL,AL     ;put char in DL
MOV     AH,02     ;write DL to CON
INT     21        ; thru DOS
DEC     CH        ;char counter
JNZ     011F      ;loop
RET

R CX
36
W
Q
```

Figure 5: *A vector address printing program.*

either replace or work with the DOS CEH.

In installing our own CEH, our programs should save the address of the current Int 24h handler and replace the vector with the address of our CEH. This should be done with the DOS Int 21h functions 35h (Get Interrupt Vector) and 25h (Set Interrupt Vector). Although the default CEH is restored automatically upon program termination, the old vector should still be saved and restored, both as a matter of good programming practice and to ensure future compatibility.

To let DOS handle the error, our CEH routine should next push the flag register onto the stack and execute a FAR CALL to the old CEH. This sets the stack for a proper return when the DOS CEH issues an IRET. DOS will issue the "Abort, Retry, Ignore" prompt, take the appropriate action, and then (except for Abort) pass control back to our program. As long as our program saves and restores the registers, we can then repaint the screen, display a message, or simply continue. This approach lets DOS handle the errors.

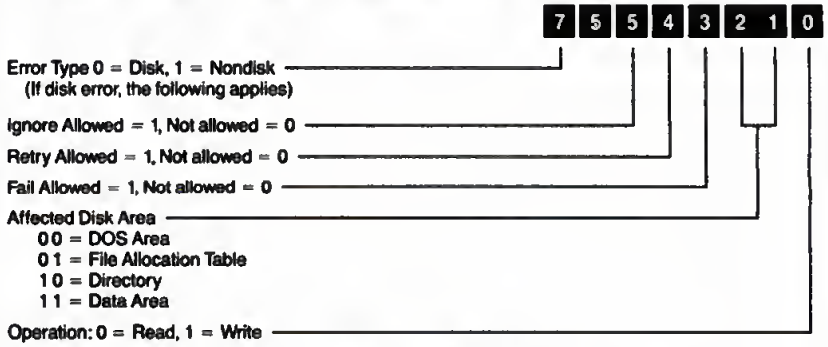
If we decide our programs should handle the error internally, they must perform their work within certain restrictions. First, since an Int 21h call was in progress when the error occurred, the use of the DOS Int 21h is limited to subfunctions 01h–0Ch and 59h. Any other call will destroy the information in DOS's internal stack from the original Int 21h and will cause the PC to lock up. The full range of BIOS functions is available, but other than the display functions, their use is not recommended because of the unknown state of the computer.

Once our CEH receives control, it must find out what has happened and perform some corrective action. For our program to deal effectively with the error, we might want control passed to a recovery or initialization routine on return from the CEH. First, the last three words should be removed from the stack and discarded. Then a FAR JUMP to the desired routine is executed. Alternately, the address of the routine could be pushed onto the stack, segment first, then offset. A FAR RET would then transfer control to the recovery routine. The registers could then be used for instructions to the recovery routine indicating actions to be performed.

When the CEH has completed its work it should discard the top three words on the stack, which were put there by the call to Int 24h. This can be done with the POP instruction or by adding 6 to the stack pointer (SP). The program registers should then be restored from the stack, leaving only the last three words on the user stack. When an IRET is executed, the program operation will continue at the instruction following the original Int 21h function request. If this is done, however, DOS will be in an unsta-

AH Error Codes

● On entry to the error handler, AH contains the following:



● If bit 7 = 0 (disk error) then AL contains the failing drive (0 = A)

● If bit 7 = 1, the error occurred on a character device, or was the result of a bad memory image of the FAT. The high bit of Offset 4 into the device header at BP:SI = 1 if block device, 0 if character. If a character device is involved, AL is undefined, and DI has error code.

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CIRCLE 221 ON READER SERVICE CARD

■ PC LAB NOTES

Stack on Entry to CEH

● When an Int 24h is issued, SS:SP points to the stack of the applications program and contains the following values, from top to bottom:

IP CS FLAGS	DOS registers from issuing Int 24
AX BX CX DX SI DI BP DS ES	User registers at time of original Int 21 request
IP CS FLAGS	From the original Int 21 request from the user to DOS

● The registers are set such that if an IRET is executed, DOS responds according to (AL) as follows:

(AL) = 0	Ignore the error
= 1	Retry the operation
= 2	Terminate the program through Int 23H (Ctrl-Break)
= 3	Fail the system call that is in progress

SAFARI BY MODEM

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If you use the Xmodem protocol, you can download SAFARI.COM directly, saving the time otherwise needed for typing or downloading either the .BAS or the .ASM version. SAFARI.BAS, whether entered from the magazine at your keyboard or downloaded from PC-IRS, will automatically create SAFARI.COM when you run it once in BASIC. SAFARI.ASM, also listed both here and on PC-IRS, allows you to modify the program, but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and to execute the following command sequence:

```
MASM SAFARI;
LINK SAFARI;
EXE2BIN SAFARI SAFARI.COM
```

ble state until a function call higher than 0Ch is issued. This means that some of DOS's internal flags will still be set to indicate that an error is in process.

RESIDENT INTERRUPT HANDLER

Naturally I've just been describing what SAFARI does. Its .ASM listing is well commented, so details of the program's operation won't be repeated here, and even nonassembly code programmers should be able to follow the program logic. After a short look at SAFARI's general operation I'll show you the trick used to patch it permanently into DOS.

When the Int 24h is executed, control is passed to SAFARI. The first responsibility of an interrupt handler is to enable other interrupts with the STI instruction. SAFARI must now gather information about the error while preserving the contents of the registers. Control will be passed to DOS later, so no information may be destroyed. The attribute byte from the device header pointed to by BP:SI is retrieved and stored. This is done first because the BP register is used to establish a reference for access to the stack. The AX and DI registers are also copied to local storage.

All the critical registers are pushed on the stack in order to preserve their values. This operation requires 9 words of storage in addition to the 15 already used by the original Int 21h and Int 24h. Since interrupts are enabled, other routines will also be accessing the stack, and they will require their own storage. This illustrates the need for an adequate stack. The current display page, cursor position, and screen contents are saved in a local storage buffer so that the screen can be restored to its original state after the CEH has completed.

The remainder of the program performs the error analysis discussed in this article and displays the results in the window. The contents of the stack are selectively retrieved and formatted for display. Figure 1 shows what the contents of the SAFARI window might be during a Critical Interrupt. The hex numbers shown are the contents of the registers when the original Int 21h function call was made. CS:IP points to the instruction that immediately follows the Int 21h. This gives the location of the instruction causing the error. The function requested can be found in AH.

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CIRCLE 102 ON READER SERVICE CARD

■ PC LAB NOTES

```
;-----------------------------------------------------------------------
;  SAFARI - Staying Away From Abort, Retry, Ignore
;  a resident interrupt handler for the DOS critical error handler
;  Tested in PC-DOS 2.0 to 3.31
;-----------------------------------------------------------------------
CSEG    SEGMENT PARA    PUBLIC  'CODE'

        ASSUME  CS:CSEG,DS:NOTHING,ES:NOTHING,SS:NOTHING

                MOV     100H                    ;SKIP TO END OF THE CFP
ENTPT:          JMP     INITIALISE              ;COM FILE ENTRY    ALWAYS AT 100H

COPYRIGHT       DB      "SAFARI 1.0 (C) Biff Communications Co.0"
PROGRAMMER      DB      "Robert L. Hummel"

;-----------------------------------------------------------------------
;       Program data area.  Buffers at end of resident code.
;-----------------------------------------------------------------------
MOV_ATTR        EQU     47H                     ;Window color: 70 for B/W
SCOL            EQU     0                       ;Window top left column
SROW            EQU     4                       ;Window top left row
BCOL            EQU     48                      ;Width of window
NROW            EQU     15                      ;Length of window

DISPLAY_PAGE    DB      0                       ;Hold current value
CURSOR_POS      DW      0                       ;Hold carract value

OLD_INT_2F      DD      0                       ;Address of original Handler
DI_MOV          DB      0,0                     ;Local storage for error codes
AX_ERR          DB      0,0                     ; ax low-byte, hi-byte
ATTR_BYTE       DB      0                       ;From device header

; Strings encoded as SCL, row, ASCIIZ

HEADER          DB      SCOL,SROW,"<< SAFARI Critical Error Handler >>",0
DISK_ERR        DB      SCOL+1,SROW+1,"System reports A Disk Error",0
CHAR_DEV_ERR    DB      SCOL+1,SROW+1,"System reports A Character Device Error",0
BAD_FAT_ERR     DB      SCOL+1,SROW+1,"System Reports A Bad FAT",0

ERR_TABLE       DB      ERR0,MSG1,ERR2,ERR3,ERR4,ERR5,ERR6,ERR7
                DB      ERR8,MSG9,ERRA,ERRB,ERRC
ERR0            DB      SCOL+1,SROW+2
                DB      "Attempt To Write On Write-Protected Diskette",0
MSG1            DB      SCOL+1,SROW+2,"Unknown Or Bad Unit",0
ERR2            DB      SCOL+1,SROW+2,"Drive Not Ready",0
ERR3            DB      SCOL+1,SROW+2,"Unknown Command",0
ERR4            DB      SCOL+1,SROW+2,"Data Error (CRC)",0
ERR5            DB      SCOL+1,SROW+2,"Bad Request Structure Length",0
ERR6            DB      SCOL+1,SROW+2,"Seek Error",0
ERR7            DB      SCOL+1,SROW+2,"Unknown media type",0
ERR8            DB      SCOL+1,SROW+2,"Sector Not Found",0
ERR9            DB      SCOL+1,SROW+2,"Printer Out Of Paper",0
ERRA            DB      SCOL+1,SROW+2,"Write Fault",0
ERRB            DB      SCOL+1,SROW+2,"Read Fault",0
ERRC            DB      SCOL+1,SROW+2,"General Failure",0
DRIVE_MSG       DB      SCOL+1,SROW+3,"On Drive "
DRIVE_NAME      DB      "A:",0

READ_OPER       DB      SCOL+1,SROW+4,"During A Read Operation",0
WRITE_OPER      DB      SCOL+1,SROW+4,"During A Write Operation",0

AREA_ERR        DB      SCOL+1,SROW+5,"Error Localized to",0
AREA_TABLE      DW      ERR_AREA,FAT_AREA,DIR_AREA,DATA_AREA
ERR_AREA        DB      SCOL+1,SROW+6,"ERROR Area",0
FAT_AREA        DB      SCOL+1,SROW+6,"File Allocation Table",0
DIR_AREA        DB      SCOL+1,SROW+6,"Directory Area",0
DATA_AREA       DB      SCOL+1,SROW+6,"Data Area",0

REG_BLK1        DB      SCOL+1,SROW+ 8,"AX=0000 BX=0000 CX=0000 DX=0000",0
REG_BLK2        DB      SCOL+1,SROW+ 9,"DS=0000 SI=0000 ES=0000 DI=0000",0
REG_BLK3        DB      SCOL+1,SROW+10,"CS:IP=0000:0000",0

;-----------------------------------------------------------------------
; Control is passed here by the jump or inserted into the DOS Int 2F handler
;-----------------------------------------------------------------------
INT_2F          PROC    FAR

                STI                             ;Allow Interrupts

                PUSHF                           ;Save used registers
                PUSH    AX
                PUSH    DS

                MOV     DS,BP                   ;Set Device Header attribute
                MOV     AX,[SI+4]               ; byte before changing DS
                MOV     CS:ATTR_BYTE,AH

                MOV     DS                      ;Restore
                POP     AX

                PUSH    BP                      ;Access to stack
                MOV     BP,SP                   ;Before we push anything

                MOV     WORD PTR CS:BX_REG,BX   ;Error status
                MOV     WORD PTR CS:DI_REG,DI   ;Error code in lower half

                PUSHF                           ;Save the state of the machine
                PUSH    ES                      ; because we're gonna make
                PUSH    DS                      ; a mess of it
                PUSH    DI
                PUSH    SI
                PUSH    DX
                PUSH    CX
                PUSH    AX
                PUSH    AX

                MOV     BX,CS                   ;Get up errors to local data
                MOV     DS,AX
                MOV     ES,AX

        ASSUME  DS:CSEG, ES:CSEG                ;Tell the assembler

;-----------------------------------------------------------------------
; Save the details of the current errors for later restoration.
;-----------------------------------------------------------------------
                MOV     AX,0F00H                ;Get current video code in
                INT     10H                     ;Thru BIOS
                MOV     DISPLAY_PAGE,BH         ;Save current page

                MOV     AH,2                    ;Get cursor position in
                INT     10H                     ;Thru BIOS
                MOV     CURSOR_POS,DX           ;Save position for
                                                ;restoration on exit
;-----------------------------------------------------------------------
; Save section of screen we will be writing over.
;-----------------------------------------------------------------------
                MOV     BH,DISPLAY_PAGE
                CLD                             ;String moves forward
                MOV     DI,OFFSET SCREEN_BUFFER ;Destination for save
                MOV     CX,NROW                 ;Row loop
                MOV     DH,SROW                 ;Init row pointer
SAV_LOOP1:
                PUSH    CX                      ;Prepare for...
                MOV     CX,NCOL                 ;...column loop
                MOV     DL,SCOL                 ;Column pointer
COL_LOOP1:
                MOV     AH,2                    ;Position cursor in
                INT     10H                     ;Thru BIOS

                MOV     AH,8                    ;Get char & attribute in
                INT     10H                     ;Thru BIOS

                STOSW                           ;ES:[di]<-ax ; di=+2

                INC     DL                      ;Next column
                LOOP    COL_LOOP1               ;Close Inner loop

                POP     CX                      ;Return to outer loop
                INC     DH                      ;Next row
                LOOP    ROW_LOOP1               ;Close Outer loop

;-----------------------------------------------------------------------
; Clear  a window (box) for our information on the screen.
;-----------------------------------------------------------------------
                MOV     AH,6                    ;Scroll window in
                MOV     AL,0                    ;Scroll entire window
                MOV     CH,SROW                 ;Upper row
                MOV     CL,SCOL                 ;Left column
                MOV     DH,SROW + NROW - 1      ;Bottom row in lower
                MOV     DL,SCOL + BCOL - 1      ;Right column
                MOV     BH,BOX_ATTR             ;Window color
                INT     10H                     ;Thru BIOS

;-----------------------------------------------------------------------
; Very who on are and give some information on to what happened.
;-----------------------------------------------------------------------
                MOV     DI,OFFSET HEADER
                CALL    WR_STRING

;-----------------------------------------------------------------------
; if ( AH:7 == 0 )
;       disk_error
; else if ( ATTR_BYTE:7 == 0 )
;       bad_fat
; else
;       character_device
;-----------------------------------------------------------------------
                MOV     DI,OFFSET DISK_ERR      ;AH IS ERROR, DI OK
                TEST    BX_REG[1],80H           ;Hi Bit=0 if disk error
                JZ      HARD_ERROR              ;Point and examine AL

                MOV     DI,OFFSET CHAR_DEV_ERR  ;Check Header for Bad Sat err
                TEST    ATTR_BYTE,80H
                JNZ     DI_CODE                 ;Else Dos-block device

                MOV     DI,OFFSET BAD_FAT_ERR
HARD_ERROR:
                CALL    WR_BYTE16

                MOV     AL,BX_REG[0]            ;Failing drive code
                ADD     AL,'A'                  ; Convert to ascii
                MOV     DRIVE_NAME,AL           ; and put in display string
                MOV     DI,OFFSET DRIVE_MSG     ;To drive...
                CALL    WR_STRING

                MOV     DI,OFFSET READ_OPER     ;Say what operation
                TEST    AX_REG[1],1             ;0=Read, 1=Write
                JZ      A20
                MOV     DI,OFFSET WRITE_OPER
A20:
                CALL    WR_BYTE16

                MOV     DI,OFFSET AREA_ERR      ;Say what area
                CALL    WR_STRING

                MOV     BX,DX                   ;Leaving the area bits one
                MOV     DL,AX_REG[1]            ; position to the left in the
                AND     DL,0                    ; hope on multiplying by two
                MOV     DI,AREA_TABLE[BX]       ;Offset into pointer table
DI_CODE:
                CALL    WR_STRING
                                                ;Interpret code in DI
                MOV     BX,DX
                MOV     DL,DI_REG               ;Get error code
                SHL     AX,1                    ;Make offset into table (*2)
                MOV     DI,ERR_TABLE[AX]
                CALL    WR_STRING

;-----------------------------------------------------------------------
; Perform a rudimentary traceback.  Display the available registers of the
;   original Int 21 and the program location it was called from.
;-----------------------------------------------------------------------
                MOV     DI,OFFSET REG_BLK1 + 5  ;Put digits here
                MOV     BX,[BP+8]               ;Print to send on stack
                CALL    BIN2H                   ;Convert to ascii in string
                ADD     DI,9                    ;Point to next location
                MOV     AX,[BP+10]              ;...continue the process
                CALL    BIN2H
```

(continues)

SAFARI.ASM: *The assembly language source code for SAFARI.COM*

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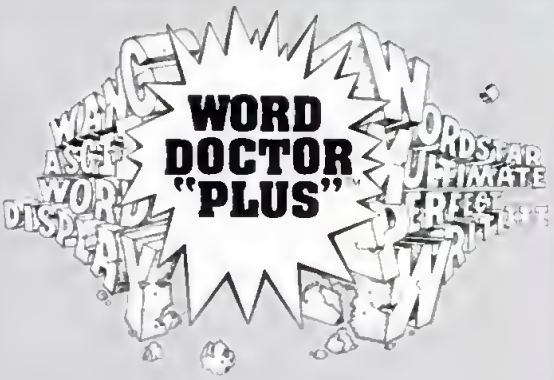
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■ PC LAB NOTES

```
                ADD     DI,8
                MOV     AX,[BP+12]
                CALL    HEX4
                ADD     DI,8
                MOV     AX,[BP+14]
                CALL    HEX4
                MOV     SI,OFFSET REG_BLK1
                CALL    AX_STRING

                MOV     SI,OFFSET REG_BLK2 + 5      ;Repeat for 2nd set Of REGS
                MOV     AX,[BP+22]
                CALL    HEX4
                ADD     DI,8
                MOV     AX,[BP+18]
                CALL    HEX4
                ADD     DI,8
                MOV     AX,[BP+24[
                CALL    HEX4
                ADD     DI,8
                MOV     AX,[BP+16]
                CALL    HEX4
                MOV     SI,OFFSET REG_BLK2
                CALL    AX_STRING

                MOV     SI,OFFSET REG_BLK3 + 6      ;Repeat for CS and IS
                MOV     AX,[BP+26]
                CALL    HEX4
                ADD     DI,5
                MOV     AX,[BP+28]
                CALL    HEX4
                MOV     SI,OFFSET REG_BLK3
                CALL    AX_STRING

                MOV     DH,DISPLAY_PAGE             ;POSition for the ANIT msg
                MOV     DH,NROW + 12                ;DH=row
                MOV     DL,NCOL                     ;DL=col

                MOV     AH,2                        ;ANt cursor posn fn
                INT     10H                         ;Thru BIAN

;-----------------------------------------------------------------
; Restore the state of the machine when Int 24 occured
;-----------------------------------------------------------------
                POP     AX
                POP     AX
                POP     CX
                POP     DX
                POP     SI
                POP     DI
                POP     DS
                POP     ES
                POPF
                POP     BP
        ASSUME  DS:NOTHING, ES:NOTHING

;-----------------------------------------------------------------
; Here is the original Int 24 handler splice.  Simulate an interrupt
;-----------------------------------------------------------------
                PUSHF                               ;Push the flags
                CLI                                 ;Disable interrupts
                PUSH    CS                          ;Push the CS register
                MOV     SI,OFFSET CX:RET_TARGET     ;Get addr of ANxt instr.
                PUSH    SI                          ; on stack too.
                MOV     SI,WORD PTR CS:DI_REG       ;Restore register
PREFIX:
                DB      5 DUP(?)                    ;First 5 bytes of old 24h
                JMP     DWORD PTR CX:OLD_INT_24     ;Transfer control to old 24h

;-----------------------------------------------------------------
;  INT transfers control here.  Again, save the machine state and set up
;         registers to access data.
;-----------------------------------------------------------------
RET_TARGET:
                PUSHF
                PUSH    AX
                PUSH    AX
                PUSH    BP
                PUSH    SI
                PUSH    DI
                PUSH    DX
                PUSH    CX
                PUSH    BX
                PUSH    AX

                MOV     AX,CX
                MOV     DS,AX
                MOV     AX,AX
        ASSUME  DS:CSEG, ES:CSEG                    ;Tell the assembler

;-----------------------------------------------------------------
;  Restore the AXregs to original state.
;-----------------------------------------------------------------
                MOV     DH,DISPLAY_PAGE             ;Just to be sure, reset page
                MOV     AH,2                        ;Set cursor positIAN fn
                MOV     DH,NROW                     ;Top of window
                MOV     DL,NCOL                     ;Column
                INT     10H                         ;Thru BIOS

                MOV     SI,OFFSET SCREEN_BUFFER     ;origin for restoratIon
                MOV     CX,NROW                     ;Row loop
                MOV     DH,NROW                     ;Init row pointer
NOV_LOOP2:
                PUSH    CX                          ;Prepare for...
                MOV     CX,NCOL                     ;...columN loop
                MOV     DL,NCOL                     ;Column Pointer
COL_LOOP2:
                PUSH    CX                          ;Need for write-char fn

                MOV     AH,2                        ;Position cursor fn
                INT     10H                         ;Thru BIAN

                LODSW                               ;AX <- [AX]
                                                    ;AH=ATTR AL=CHAR
                MOV     BL,AH                       ;Put attribute where needed
                MOV     AH,9                        ;Write char fn
                MOV     CX,01                       ;Write one copy of char
                INT     10H                         ;Thru BIAN

                INC     DL                          ;Next column
                POP     CX                          ;Restore Countar
                LOOP    COL_LOOP2                   ;Close loner loop

                POP     CX                          ;ANturn to outer loop
                Inc     DH                          ;Next row
                LOOP    NOV_LOOP2                   ;Close ANter loop

                MOV     AH,2                        ;Set Cursor position fn
                MOV     DH,CURSOR_POS               ;ANstore old cursor position
                INT     10H                         ;Thru BIOS

                POP     AX
                POP     BX
                POP     CX
                POP     DX
                POP     SI
                POP     DI
                POP     BP
                POP     AX
                POP     DS
                POPF
                IRET                                ;And we return too

INT_24          ENDP

;-----------------------------------------------------------------
;  All accass to the BIAN video interrupt comes through here.  Some BIANs
;  destroy BP during a INT 10h call.
;-----------------------------------------------------------------
VIDEO           PROC    NEAR

                PUSH    BP
                INT     10H
                POP     BP
                RET

VIDEO           ENDP

;-----------------------------------------------------------------
;         HEX4 -  Convert the AX register to hexidecimal Digits.
;                 The characters produced are stored at ES:DI.
;                 All regs preserved.
;-----------------------------------------------------------------
HEX4    PROC    NEAR
                PUSH    BX
                PUSH    DX
                PUSH    CX

                MOV     AH,AH
                STD                                 ;String ptr decrement
                ADD     DI,3                        ;Point to end Of string
                MOV     CX,4
H1S:
                MOV     AL,BL                       ;Get lower half
                AND     AL,0FH                      ; Of this byte
                ADD     AL,90H                      ;Convert AL to ASCII
                DAA
                ADC     AL,40H
                DAA
                STOSB                               ;Store at ES:DI
                SUB     BX,1
                SHR     AX,1
                SAR     AX,1
                SAR     AX,1
                SAR     AX,1
                LOOP    H1S

                POP     CX
                POP     BX
                POP     AX
                Inc     DI
                CLD
                RET
HEX4    ENDP
;-----------------------------------------------------------------
; WR_STRIAN - write string to console at specified location.
;         The first two bytes of the string contain the column and row of the
;         Display location.  The remainder of the string is ASCIIZ.
;         AX is destroyed, all other registers are preserved.
;-----------------------------------------------------------------
AX_STRING       PROC    NEAR

                PUSH    AX
                PUSH    CX
                PUSH    SI

                MOV     BH,DISPLAY_PAGE
                MOV     DX,[SI]                     ;DH=row, DL=col
                MOV     AH,2                        ;Set cursor posn fn
                INT     10H                         ;Thru BIOS
                Inc     SI                          ;Point to start of string
NEXT_CHAR:
                LODSB                               ;Load char in AL from AX:SI
                OR      AL,AL                       ;If char is 0
                JZ      END_STRING                  ;End of ASCIIZ string
                MOV     AH,0AH                      ;Else, write TTY
                INT     10H                         ;Thru BIAN
                JMP     SHORT NEXT_CHAR
END_STRIAN:
                POP     SI
                POP     CX
                POP     BX
                RET

AX_STRING       ENDP

;-----------------------------------------------------------------
PC              =       $

SCREEN_BUFFER   =       PC
PC              =       PC + NROW * NCOL * 2

LASTBYTE        =       PC
```

(SAFARI.ASM continues)

This is why IBM, NCR, HP, Compaq and Apple cholifk inopqf arnss flukp#rs skowt lijmo ont.

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■ PC LAB NOTES

```
;-----------------------------------------------------------------------
;  Initialization Procedure
;  Patch command.com to load our handler as the new default
;-----------------------------------------------------------------------
INITIALIZE      PROC    NEAR
        ASSUME  CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG         ;Set by loader.

                MOV     AH,6
                MOV     DX,OFFSET COPYRIGHT
                INT     21H
;-----------------------------------------------------------------------
; Get the current address of Int 24 and save
;-----------------------------------------------------------------------
                MOV     AX,3524                         ;Get Int vector
                MOV     AL,24H                          ;For this Int
                INT     21H                             ;Result in ES:BX
        ASSUME  ES:NOTHING
                CMP     BYTE PTR ES:[BX],0EAH           ;If code is jump
                JNE     NOT_INSTALLED

                MOV     AX,4C81H                        ;Terminate with error
                INT     21H
NOT_INSTALLED:
                MOV     WORD PTR OLD_INT_24[6],BX               ;Offset
                MOV     WORD PTR OLD_INT_24[2],ES               ;Segment

;-----------------------------------------------------------------------
; Copy the first five bytes of the DOS Int 24 handler to our handler.
;-----------------------------------------------------------------------
                MOV     CX,5                            ;Move 5 bytes
                PUSH    ES                              ;From old handler (DS:SI)
                POP     DS
        ASSUME  DS:NOTHING
                MOV     SI,BX
                PUSH    CS                              ;To a safe place (ES:DI)
                POP     ES
        ASSUME  ES:CSEG
                MOV     DI,OFFSET PREFIX
                REP     MOVSB

;-----------------------------------------------------------------------
; Build our jump command inside the original Int 24 handler to
;       pass control immediately to our handler.
;-----------------------------------------------------------------------
                PUSH    ES                              ;Point ES to
                POP     ES                              ; the old handler
        ASSUME  ES:NOTHING
                MOV     DI,BX                           ;Write to ES:DI
                MOV     AL,0EAH                         ;Opcode for far jump
                STOSB
                MOV     AX,OFFSET INT_24                ;Offset of our handler
                STOSW
                MOV     AX,CS
                STOSW
                ADD     WORD PTR CS:OLD_INT_24,5 ;Point after jump

;-----------------------------------------------------------------------
; Terminate and stay resident.
;-----------------------------------------------------------------------
                MOV     AH,3168H
                MOV     DX,(OFFSET LASTBYTE - OFFSET CSEG + 15) SHR 4
                INT     21H

INITIALIZE      ENDP

CSEG    ENDS
        END     ENTRY
```

(SAFARI.ASM ends)

```
100 REM -- BASIC PROGRAM TO CREATE safari.COM
110 OPEN "safari.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR J = 1 TO  169
150    L1NESUM = 0
155    PRINT ",";
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ L3NECHECK
240    IF L3NECHECK <> L3NESUM THEN PRINT "Error in Line";200 + 10 * J
250 NEXT J
260 CLOSE
270 IF CHECKSUM = 116555 THEN PRINT "Successful Completion:" : END
280 PRINT "COM file is not valid!" : END
290 DATA    223,   250,     4,    82,    65,    70,    65,    82,   852
300 DATA     73,    32,    46,    46,    46,    32,    46,    99,   419
310 DATA     41,    32,    68,   105,   102,   102,    22,    67,   571
320 DATA    111,   109,   109,   117,   110,   105,    99,    97,   857
330 DATA    116,   105,   111,   110,   115,    32,    67,   111,   767
340 DATA     46,    36,    82,   111,    98,   101,   114,   116,   784
350 DATA     32,    76,    46,    22,    72,   117,   109,   109,   593
360 DATA    101,   100,     0,     0,     0,     0,     0,     0,   209
370 DATA      0,     0,     0,     0,     0,     0,     0,     4,     4
380 DATA     68,    68,    32,    83,    65,    70,    65,    82,   517
390 DATA     73,    32,    67,   114,   105,   116,   105,    96,   711
400 DATA     97,   108,    32,    69,   114,   114,   111,   114,   759
410 DATA     32,    72,    97,   110,   100,   100,   101,   114,   734
420 DATA     32,    62,    62,     8,     1,     5,    83,   121,   266
430 DATA    115,   116,   101,   109,    32,    82,   101,   112,   766
440 DATA    311,   114,   116,   115,    32,    65,    32,    68,   653
450 DATA    105,   115,   107,    32,    69,   114,   114,   111,   767
460 DATA    314,     8,     1,     5,    83,   121,   115,   116,   555
470 DATA    101,   109,    32,    82,   101,   112,   111,   114,   762
480 DATA    116,   115,    32,    65,    32,    67,   104,    97,   626
490 DATA    114,    97,    99,   116,   101,   114,    32,    68,   741
500 DATA    101,   110,   105,    99,   101,    32,    69,   114,   736
510 DATA    114,   111,   114,     8,     1,     5,    83,   121,   546
520 DATA    115,   116,   101,   109,    32,    82,   101,   112,   768
530 DATA    111,   114,   116,   115,    32,    65,    32,    66,   651
540 DATA     97,   100,    22,    78,    65,    84,     8,   233,   601
550 DATA      3,    24,     2,    46,     2,    64,     2,    82,   223
560 DATA      2,   101,     2,   132,     2,   145,     2,   166,   552
570 DATA      2,   105,     2,   288,     2,   222,     2,   235,   856
580 DATA      2,     3,     6,    65,   116,   116,   101,   106,   516
590 DATA    112,   116,    22,    84,   111,    22,    87,   114,   606
600 DATA    105,   116,   101,    22,    79,   110,    32,    87,   662
610 DATA    114,   105,   116,   101,    45,    88,   114,   111,   786
620 DATA    116,   101,    99,   116,   101,   100,    22,    68,   733
630 DATA    105,   115,   107,   101,   116,   116,   101,     8,   761
640 DATA      1,     6,    85,   110,   107,   110,   111,   119,   649
650 DATA    110,    32,    79,   114,    32,    66,    97,   100,   630
660 DATA     32,    85,   110,   105,   116,     8,     1,     6,   455
670 DATA     88,   116,   105,   110,   101,    32,    78,   131,   727
680 DATA    116,    32,    82,   101,    97,   100,   121,     8,   649
690 DATA      1,     6,    85,   110,   107,   110,   111,   119,   649
700 DATA    110,    32,    67,   111,   109,   109,    97,   110,   745
710 DATA    100,     8,     1,     6,    68,    97,   116,    97,   485
720 DATA     32,    69,   114,   114,   111,   114,    32,    40,   626
730 DATA     67,    82,    67,    41,     8,     1,     6,    66,   330
740 DATA     67,   100,    32,    82,   101,   113,   117,   101,   743
750 DATA    115,   116,    32,    83,   116,   114,   117,    99,   792
760 DATA    116,   117,   114,   101,    22,    76,   101,   110,   767
770 DATA    163,   116,   104,     8,     1,     6,    82,   101,   514
780 DATA    161,   107,    32,    66,   114,   114,   111,   114,   762
790 DATA      8,     1,     6,    85,   110,   107,   110,   111,   530
800 DATA    119,   110,    32,   106,   101,   100,   105,    97,   773
810 DATA     32,   116,   121,   112,   101,     8,     1,     6,   489
820 DATA     83,   101,    99,   116,   111,   114,    22,    78,   724
830 DATA    111,   116,    32,    78,   111,   117,   110,   100,   767
840 DATA      8,     1,     6,    88,   114,   105,   110,   116,   532
850 DATA    101,   114,    32,    76,   117,   114,    32,    79,   670
860 DATA    102,    22,    88,    97,   112,   101,   114,     8,   638
870 DATA      1,     6,    87,   114,   105,   116,   101,    32,   562
880 DATA     78,    97,   117,   100,   116,     8,     1,     6,   515
890 DATA     82,   101,    97,   100,    32,    78,    97,   117,   666
900 DATA    168,   116,     8,     1,     6,    71,   101,   110,   513
910 DATA    101,   114,    97,   100,    32,    78,    97,   105,   724
920 DATA    116,   117,   114,   101,     8,     1,     7,    76,   527
930 DATA    110,    32,    68,   114,   105,   118,   101,    32,   688
940 DATA     65,    58,     8,     1,     8,    68,   117,   114,   431
950 DATA    105,   110,   102,    32,    65,    22,    82,   101,   638
960 DATA     97,   100,    22,    79,   112,   101,   114,    97,   732
970 DATA    116,   105,   111,   110,     8,     1,     8,    66,   519
980 DATA    117,   116,   105,   110,   103,    32,    65,    32,   670
990 DATA     87,   116,   105,   116,   101,    32,    76,   112,   746
1000 DATA   101,   114,    97,   116,   105,   111,   110,     8,   754
1010 DATA     1,     9,    69,   114,   114,   111,   114,    32,   564
1020 DATA    76,   111,    99,    67,   100,   105,   122,   101,   819
1030 DATA   100,    32,    73,   110,     8,    93,     2,   104,   515
1040 DATA     3,   126,     2,   145,     3,     1,    10,    68,   361
1050 DATA    79,    83,    22,    65,   114,   101,    97,     8,   571
1060 DATA     1,    10,    78,   105,   108,   101,    22,    65,   492
1070 DATA   108,   108,   113,    99,    97,   116,   105,   111,   855
1080 DATA   110,    32,    84,    97,    98,   100,   101,     8,   638
1090 DATA     1,    10,    68,   105,   116,   101,    99,   116,   614
1100 DATA   111,   116,   121,    32,    65,   114,   101,    97,   755
1110 DATA     8,     1,    10,    68,    97,   116,    97,    32,   421
1120 DATA    65,   116,   101,    97,     8,     1,    12,    65,   655
1130 DATA    88,    61,    48,    48,    48,    48,    32,    66,   436
1140 DATA    88,    61,    48,    48,    48,    48,    32,    67,   440
1150 DATA    88,    61,    48,    48,    48,    48,    22,    68,   441
1160 DATA    88,    61,    48,    48,    48,    48,     8,     1,   342
1170 DATA    13,    68,    83,    61,    48,    48,    48,    48,   417
1180 DATA    22,    83,    73,    61,    48,    48,    48,    48,   441
1190 DATA    32,    69,    82,    61,    48,    48,    48,    48,   437
1200 DATA    32,    68,    73,    61,    48,    48,    48,    48,   426
1210 DATA     8,     1,    14,    67,    83,    58,    73,    88,   376
1220 DATA    61,    48,    48,    48,    48,    58,    48,    48,   407
1230 DATA    48,    48,     8,   251,    88,    38,   142,   221,   828
1240 DATA   129,    68,     4,    46,   136,    38,    69,     1,   501
1250 DATA    31,    88,    85,   139,   236,    46,   162,    67,   855
1260 DATA     1,    46,   137,    62,    65,     1,   156,     6,   474
1270 DATA    28,    87,    86,    82,    81,    83,    88,   140,   669
1280 DATA   280,   142,   216,   142,   162,   100,    15,   285,  1292
1290 DATA    16,   136,    62,    58,     1,   100,     3,   285,   661
1300 DATA    16,   137,    22,    59,     3,   138,    82,    58,   493
1310 DATA     1,   252,   191,   253,     5,   105,    15,     8,   902
1320 DATA   102,     6,    81,   105,    46,     8,   178,     8,   676
1330 DATA   100,     2,   285,    16,   100,     8,   205,    16,   812
1340 DATA   171,   254,   194,   226,   243,    89,   254,   198,  1629
1350 DATA   226,   232,   100,     6,   176,     8,   101,     4,  1085
1360 DATA   177,     8,   102,    10,   178,    45,   103,    79,   862
```

(continues)

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■ PC LAB NOTES

```
1370 DATA  209,   16,  190,   70,    1,  232,  119,    1,  834
1380 DATA  190,  100,    1,  246,    6,   60,    1,  120,  740
1390 DATA  116,   13,  190,  130,    1,  246,    6,   69,  779
1400 DATA    1,  120,  117,   59,  190,  100,    1,  232,  906
1410 DATA   53,    1,  160,   67,    1,    4,   85,  162,  993
1420 DATA    0,    3,  190,  293,    2,  232,   75,    1,  760
1430 DATA  190,   11,    3,  246,    6,   60,    1,    1,  926
1440 DATA  116,    3,  190,   37,    3,  232,   63,    1,  645
1450 DATA  190,   64,    3,  232,   97,    1,   50,  255,  852
1460 DATA  130,   30,   60,    1,  120,  227,    6,  139,  737
1470 DATA  103,   69,    3,  232,   41,    1,   90,  299,  850
1480 DATA  130,   30,   65,    1,  209,  227,  139,  103,  992
1490 DATA  307,    1,  232,   26,    1,  191,  162,    3,  823
1500 DATA  139,   70,    0,  232,  234,    0,  131,  199, 1013
1510 DATA    0,  139,   70,   10,  232,  225,    0,  131,  815
1520 DATA  199,    0,  139,   70,   12,  232,  216,    0,  876
1530 DATA  131,  199,    0,  139,   70,   14,  232,  307, 1000
1540 DATA    0,  190,  157,    3,  232,  240,    0,  191, 1013
1550 DATA  196,    3,  139,   70,   22,  232,  192,    0,  854
1560 DATA  131,  199,    0,  135,   70,   16,  232,  103,  978
1570 DATA    0,  131,  199,    0,  139,   70,   24,  232,  803
1580 DATA  174,    0,  131,  199,    0,  139,   70,   18,  739
1590 DATA  232,  165,    0,  190,  191,    3,  232,  198, 1211
1600 DATA    0,  191,  233,    3,  139,   70,   20,  232,  896
1610 DATA  150,    0,  131,  199,    9,  139,   70,   26,  720
1620 DATA  232,  141,    0,  190,  229,    3,  232,  174, 1197
1630 DATA    0,  130,   62,   58,    1,  102,   16,  170,  639
1640 DATA    0,  100,    2,  209,   16,   80,   91,   89,  871
1650 DATA   90,   94,   99,   31,    7,  197,   93,  196,  723
1660 DATA  250,   14,  191,   93,    9,   87,   46,  139,  825
1670 DATA   62,   69,    1,    0,    0,    0,    0,    0,  120
```

```
1680 DATA   46,  259,   46,   61,    1,  156,    0,   30,  601
1690 DATA   89,   87,   86,   82,   81,   83,   80,  140,  724
1700 DATA  200,  142,  216,  142,  192,  130,   62,   50, 1150
1710 DATA    1,  100,    2,  102,    4,  170,    0,  209,  752
1720 DATA   16,  190,  293,    5,  105,   19,    0,  102,  846
1730 DATA    4,   81,  109,   46,    0,  170,    0,   81,  575
1740 DATA  100,    2,  205,   16,  173,  130,  220,  100, 1116
1750 DATA    9,  105,    1,    0,  209,   16,  294,  194,  864
1760 DATA   89,  226,  236,   89,  254,  190,  226,  225, 1943
1770 DATA  100,    2,  139,   22,   99,    1,  209,   10,  824
1780 DATA   80,   91,   89,   90,   94,   99,   83,   31,  671
1790 DATA    7,  197,  207,   85,  309,   16,   93,  199,  969
1800 DATA   80,   83,   81,  139,  216,  293,  121,  199, 1102
1810 DATA    3,  109,    4,    0,  130,  199,   26,   19,  974
1820 DATA    6,  144,   39,   20,   64,   39,  170,  209,  689
1830 DATA  239,  209,  235,  209,  235,  209,  239,  226, 1793
1840 DATA  239,   89,   91,   80,   71,  252,  199,   83, 1184
1850 DATA   82,   86,  130,   62,   90,    1,  130,   20,  986
1860 DATA  100,    2,  209,   16,   70,   70,  172,   10,  725
1870 DATA  192,  116,    6,  100,   14,  209,   10,  235,  964
1880 DATA  245,   94,   90,   91,  199,  100,    0,  106, 1090
1890 DATA    3,    1,  209,   33,  100,   93,  176,   36,  687
1900 DATA  205,   33,   30,  120,   63,  234,  117,    9,  823
1910 DATA  104,    1,   76,  209,   33,  137,   30,   61,  727
1920 DATA    1,  140,    6,   63,    1,  109,    9,    0,  481
1930 DATA    0,   31,  139,  243,   14,    7,  191,   83,  714
1940 DATA    9,  243,  164,   30,    7,  139,  291,  176, 1019
1950 DATA  234,  170,  104,  243,    2,  171,  140,  200, 1345
1960 DATA  171,   46,  131,    0,   61,    1,    9,  104,  609
1970 DATA    0,   49,  106,  103,    0,  209,   33,    0,  696
```

(SAFARI.BAS ends)

INSTALLING SAFARI SAFARI uses a program-patching technique to become a permanently resident CEH. The installation program first gets the address of the default CEH, using Int 21h function 35h (Get Interrupt Vector). This address is saved in local storage. Next, the first 5 bytes at that address are copied into SAFARI. They are positioned in the program so that they will be executed just prior to a FAR JUMP to the sixth byte of the original CEH. When this sequence is executed, it will function identically to the original contiguous code.

Splicing SAFARI into the CEH is then accomplished by writing a FAR JUMP to the beginning of the SAFARI code over the first 5 bytes of the default CEH. When an Int 24h is issued, the default CEH will execute a FAR JUMP to SAFARI. SAFARI, after providing a bulletproof window, then simulates an interrupt by pushing the flags on the stack, followed by the segment and offset of the desired return address. The missing 5 bytes of code are executed, and a FAR JUMP puts control back into the original CEH. When the CEH is finished, an IRET transfers control back to SAFARI, where the screen is restored and control returned to the code that issued the Int 24h. The concept is really quite simple, and the table "Replacement Splicing" illustrates the process.

■ SAFARI uses a program-patching technique to become a permanently resident CEH.

Replacement Splicing

DOS CEH Before SAFARI	DOS CEH With SAFARI Splice	
STI	JMP xxxx:yyyy	→ (EXECUTE SAFARI CODE)
PUSH DS		STI
PUSH ES		PUSH DS
PUSH CX		PUSH ES
PUSH DI		PUSH CX
PUSH CX	PUSH CX	PUSH DI
PUSH AX	PUSH AX	JMP wwww.zzzz

For this to work, the content of the original code must be known and consistent. The code must be broken only on an instruction boundary; otherwise two separate, incorrect instructions will be formed. Some instructions should not be separated, such as stack pointer manipulations. But because the preamble to the CEH consists of a number of single-byte instructions, splicing is relatively easy.

RUNNING DEBUG WITH SAFARI I mentioned earlier that DEBUG changes the Int 24h address to point to itself. If an Int 24h occurs while running a program under DEBUG, control is passed to DEBUG and then to the DOS CEH by a simulated interrupt. When SAFARI gets control, an extra three words have been pushed onto the stack by DEBUG. SAFARI's register dump will therefore be incorrect, as it relies on stack position for its arguments. The same situation would apply if an application program were to force Int 24h to pass through its own CEH. If you're interested in improving SAFARI to reflect these contingencies, you can modify the program to check the Int 24h address in low memory whenever it is invoked. If the address is different than when it was originally installed then a new CEH has been installed and no stack dump should be performed. PC

Robert L. Hummel is senior technical editor of PC Magazine.

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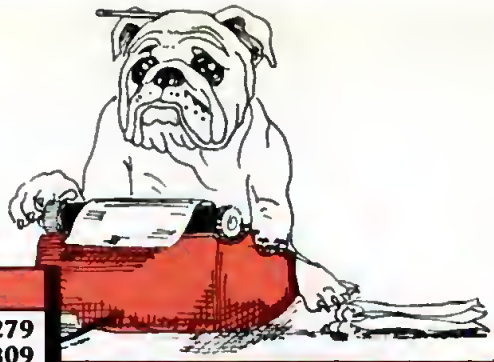
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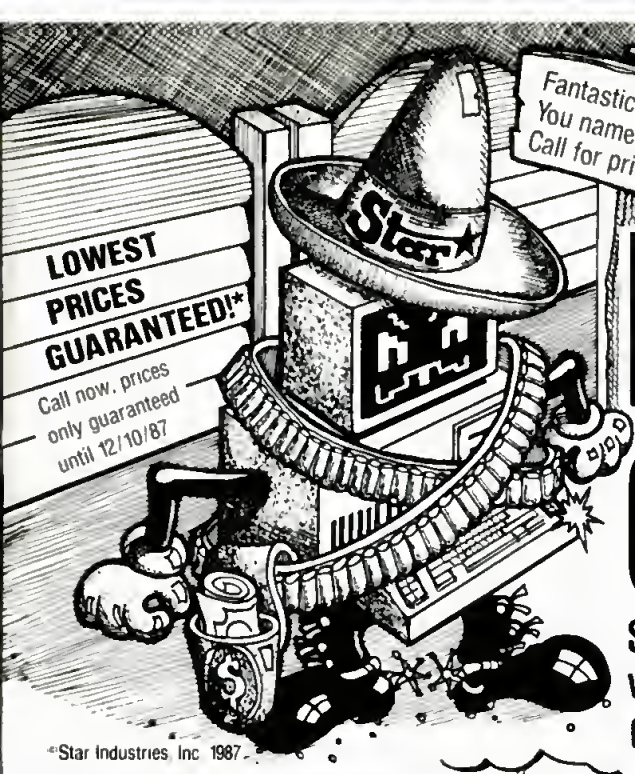
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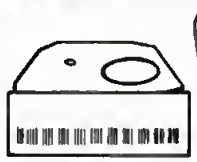
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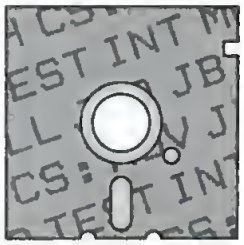
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CIRCLE 530 ON READER SERVICE CARD

■ UTILITIES ■ JEFF PROSISE

GETTING CONTROL OF YOUR CURSOR



If you want to whip your cursor into shape, or get it back onto your screen when exiting an application gives it the deep six, our CTYPE utility shows you what the job entails.

[The CTYPE utility presented here demonstrates how to change the cursor shape on most display adapters available today. The cursor shape it sets will last only until another program changes it. Part 2, in the next issue, contains a utility that makes the cursor shape semipermanent, or "sticky," overriding most attempts to reset it. It will also repair the EGA cursor emulation bug.—Ed.]

You probably spend more time thinking about Vanna White's shape than you do about the shape of the cursor you stare at all day. On the other hand, when Vanna disappears from the screen, you're not likely to be as upset as when you lose your cursor on exiting from *SideKick* while using a 43-line EGA display. I can't fix you up with Vanna, but I can do something about your cursor.

Whether you use a monochrome card, a CGA, an EGA, or even the new VGA, the blinking two-line cursor you get on power-up is always the same. Yet the video hardware is capable of supporting a wide variety of cursor shapes, from the familiar underscore to a solid block to a number of odd-looking wraparound cursors. Applications programs often use this capability to identify the current processing mode. Many editors, for example, change to a block cursor or to a thicker underline to indicate that insert mode is active.

Unless you own a special utility to customize the cursor shape, however, configuring it to your own taste involves a certain amount of effort. True, if you're comfortable with DEBUG and know a bit of assembly language, you can patch together a few bytes of code to set the cursor through interrupt 10h. But there's a catch.

The EGA BIOS has a bug in it that prevents the interrupt 10h cursor mode function from working reliably. The problem becomes acute when you use modes that display more than 25 lines on the screen. EGA users who use the special modes provided by the adapter know all too well that the cursor is often destroyed when a TSR window is popped up and back down.

Cursor utilities can range from the simplicity of a 6-byte .COM file, which resets the cursor to a given mode each time it's called, to the elegance of the program that comes bundled with *WordPerfect*. The latter provides an on-screen grid in which the cursor's starting and ending scan lines change for each position in the matrix. Thus, every possible shape the cursor can assume can be obtained with a few strokes of the arrow keys. If you have a favorite style that you find yourself setting again and again, an optional command line parameter lets you set that configuration without navigating the grid each time.

For all its sophistication, however, the *WordPerfect* utility succumbs to the same bug that infects all cursor manipulations on the EGA. Further, users who work with 40 columns are annoyed to find that the utility forces an 80-column mode reset upon them. CTYPE.COM, the utility presented



By moving the cursor within the frame, you can set its shape with CTYPE.

■ UTILITIES

in this column, borrows from *WordPerfect*'s presentation matrix but provides a cursor definition utility that works with all major adapters and is compatible with all the text-based video modes. With CTYPE you can customize the cursor to your liking or recover it from the oblivion to which a wayward program has cavalierly consigned it.

You can download CTYPE directly from the PC Magazine Interactive Reader Service, as explained in the sidebar "CTYPE by Modem." The source code, CTYPE.ASM, and CTYPE.BAS, a BASIC program that will create CTYPE .COM when run once, are listed here and are also available via PC-IRS.

USING THE PROGRAM CTYPE .COM has two modes of operation: an interactive mode in which you can experiment with different cursor shapes and view them against a line of sample text; and a command line mode that lets you set the cursor size and shape directly. The program's syntax is

```
[d:][path]CTYPE [/xy]
```

The presence or omission of the optional parameter */xy*, a slash character followed by two ASCII letters that designate the desired starting and ending scan lines, determines which of CTYPE's modes of operation is activated.

If you omit the command line qualifier, CTYPE presents you with a cursor selection frame whose horizontal and vertical legs extend outward from the letter "A" to the letter designating the maximum number of scan lines allotted to each character cell in the current video mode. For example, when an EGA is connected to an enhanced color display and 25 lines of text are displayed, each character cell has 14 scan lines. This is indicated by the letter "N". The same EGA running in 43-line mode displays an "H" at the ends of the frame, indicating eight scan lines per cell. A standard CGA does the same in any text mode. A monochrome adapter gives you an "N", i.e., 14 lines per character.

The area within the frame is filled with a matrix of dots, and each point in the grid represents one possible cursor configuration. On entry, CTYPE automatically positions the cursor at the location corresponding to the standard underline cursor, which is composed of two scan lines. The cursor will change its appearance as you move it around inside the frame with the four arrow keys.

The principle underlying these changing appearances is simple. As the cursor moves horizontally to the right or left, the ending scan line—which forms the bottom of the cursor—moves up and down, respectively. As the cursor is moved vertically, the starting scan line moves up as the cursor goes up, or down as the cursor moves downward. The result is that the cursor appears as a single line at the top of the character cell when in the upper-right-hand corner of the grid, as a solid block when in the upper-left-hand corner, and as an underscore when in the lower-left-hand corner. This covers every possible shape the cursor can take on without wrapping around on itself. If you attempt to move beyond the bounds of the grid, CTYPE will transport the cursor to the opposite end of the respective row or column.

■ CTYPE's interactive mode lets you experiment with different cursor shapes; the command line mode lets you set the cursor size and shape directly.

To see how a given cursor setting looks in relation to a line of text, just hit the Spacebar when at the selector display. Hit the Spacebar again to return to the selector frame. Press Enter to accept the cursor shape and return you to the DOS prompt.

A line immediately above the cursor selection frame continuously displays the current letter coordinates. If you decide that the cursor shape you want corresponds to position B on the horizontal and G on the vertical leg of the frame, you can thereafter set it from the command line directly, bypassing the selection process. Just enter the command

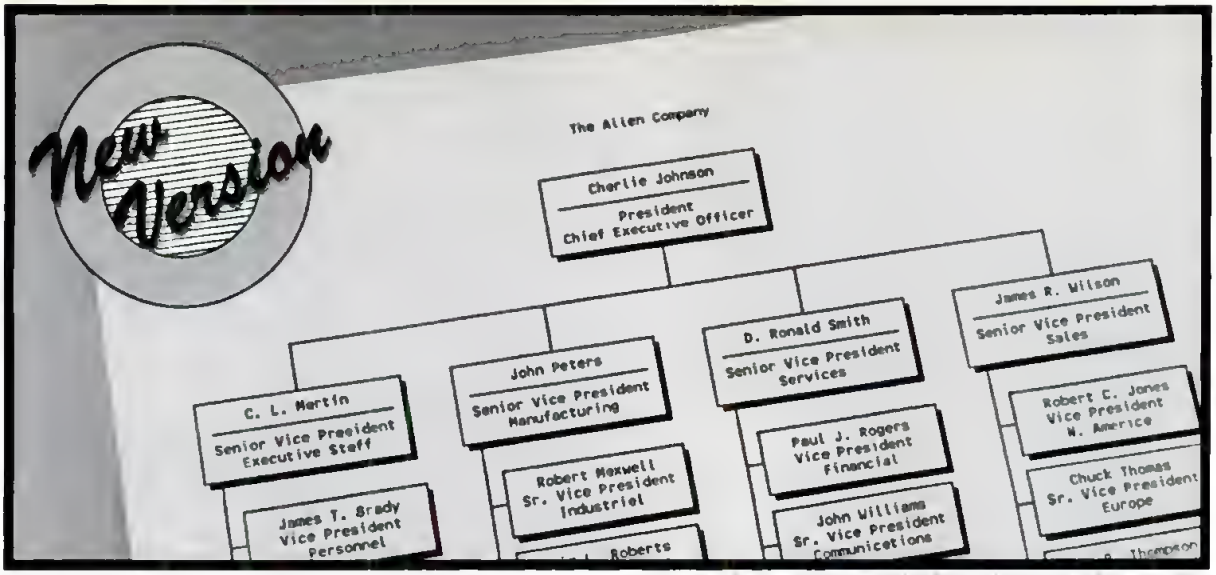
```
CTYPE /BG
```

at the DOS prompt. Running CTYPE with a command line specifier also lets you configure the cursor from an AUTOEXEC .BAT file each time you power up. The characters that make up the parameter can be typed in either upper- or lowercase, and the attempt to use a value greater than the number of scan lines displayed or to create a wraparound cursor will be greeted with the message "Illegal parameters."

It's interesting to note that an EGA supporting 350 scan lines in text mode (14 per line) doesn't default its cursor to scan lines 13 and 14. The characters themselves use lines 1 through 11, so a cursor at the extreme bottom of the block will leave an almost unnoticeable gap of one line between itself and the character it resides under. Instead, the EGA cursor uses lines 12 and 13 and for all outward appearances parallels the look of its CGA cousin. In terms of the CTYPE utility, this cursor is described by the parameter "LB"

THE CURSOR REGISTERS Both the CGA and the monochrome display adapter (MDA) are designed around Motorola's 6845 CRT Controller. This is a smart chip that provides a set of 18 internal registers supporting a wide variety of video modes and video support functions. The 18 registers are accessed through only two ports in PC address space. The first port, located at 3D4h if a CGA is installed or 3B4h for monochrome, is the Address Register. The second, found at 3D5h for color or 3B5h for monochrome, is the Data Register. Values are written by first OUTing the internal register number (0 through 17) to the Address Register, then sending the data to be written to the Data Register.

The cursor is defined by its starting and ending scan lines. A wraparound cursor occurs when the starting scan line is greater than the ending one. The 6845 sets aside an internal register for each of these parameters; the starting scan line is held in register 10 and the ending scan line in register 11. When the BIOS sets a cursor shape by executing interrupt 10h with AH equal to 1 and the cursor definition in CX, it simply transfers the values in CH and CL



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CIRCLE 367 ON READER SERVICE CARD

```
;CTYPE.COM for the IBM Personal Computer - 1987 by Jeff Prosise

bios_data       segment at 40h
                org 60h
cursor_mode     dw ?                    ;cursor scan lines
                org 63h
addr_6845       dw ?                    ;CRT Controller base address
                org 87h
ega_info        db ?                    ;EGA info byte
bios_data       ends

;-------------------------------------------------------------------------
code            segment para public 'code'
                assume cs:code,ds:code
                org 100h
begin:          jmp ctype

progrmx         db 'CTYPE 1.0 '
copyright       db '(c) 1987 Biff Communications Co.',1Ah
author          db 'Jeff Prosise'

header          db 'PC Magazine Cursor Definition Utility',0
subheader       db 'CTYPE /',0
footer1         db '< Use arrow keys to navigate grid >',0,0
                db 'ENTER     : Select cursor and exit',0
                db 'SPACEBAR : View cursor with text',0
footer2         db '< Press SPACEBAR to return >',0,0
                db 'A single line of sample text',0
errmsg          db 13,10,'Illegal parameters',13,10,'$'

adapter         db 3                    ;0=MDA, 1=CGA, 2=EGA, 3=VGA
points          label byte
lpoints         dw 0                    ;scan lines per row (default=CGA)
rows            db 24                   ;number of rows (default=CGA, MDA)
columns         db ?                    ;number of video columns
attr1           db 02h                  ;main video attribute
attr2           db 1Fh                  ;auxiliary video attribute
old_attr        db 0
deltacol        db 2                    ;space between frame columns
startcol        db ?                    ;first frame column
vpage           db ?                    ;active video page
textrow         db ?                    ;row where text footer begins

;-------------------------------------------------------------------------
;CTYPE is the main procedure.
;-------------------------------------------------------------------------
ctype           proc near
;
;Find the current color of the screen for clearing later.
;
                mov ah,15               ;get columns and page
                int 10h
                mov columns,ah          ;save them
                mov vpage,bh
                mov ah,8                ;save old screen colors
                int 10h
                mov old_attr,ah

                mov ax,bios_data        ;point ES to BIOS data area
                mov es,ax
                assume es:bios_data
;
;Determine what type of video adapter is active, whether video is color
;or monochrome, and how many scan lines make up each character box.
;
                mov ax,1A00h            ;check for a VGA
                int 10h
                cmp al,1Ah              ;is AL set to 1Ah?
                jne check_ega           ;no, then no VGA present
                cmp bl,7                ;test for active VGA
                jb check_ega
                cmp bl,8
                ja check_ega
                call SetVideoParms      ;determine rows and points
                cmp bl,7                ;reset attributes if monochrome
                je mono
                jmp short checkparm     ;done if video is color

check_ega:      dec adapter             ;assume this is an EGA
                mov ah,12h              ;video function 12h
                mov bl,10h              ;subfunction - return EGA info
                int 10h
                cmp bl,10h              ;did BL return unchanged?
                je no_ega               ;yes, then no EGA
                test ega_info,8         ;is the EGA currently active?
                jnz no_ega              ;no, then continue the check
                call SetVideoParms      ;determine rows and points
                or bh,bh                ;is BH zero?
                jns mono                ;no, then it's a mono system
                jmp short checkparm     ;yes, then it's color

no_ega:         dec adapter             ;assume this is a CGA
                test addr_6845,40h      ;is bit 6 of the CRTC address set?
                jnz checkparm           ;yes, then it's a CGA
                mov points,14           ;no, then it's an MDA
                dec adapter             ;set ADAPTER to zero for MDA
mono:           mov attr1,07h           ;alter video parameters for mono
                mov attr2,70h
;
;Check the command line for cursor definition parameters.
;
checkparm:      push cs                 ;point ES to code segment
                pop es
                assume es:code
                cld                     ;clear DF
                mov di,82h              ;point ES:DI to text of line
                cmp byte ptr [di-2],2   ;at least 2 characters entered?
                jb noparm               ;no, then nothing was entered
                mov cx,10               ;check for slash character
                mov al,'/'
                repne scasb
                jcxz noparm             ;branch if command line is empty
                mov cx,[di]             ;get 2 characters after slash
                and cx,0DFDFh           ;capitalize them
                sub cx,4141h            ;then normalize them
                cmp ch,points           ;see if they're in range
                jae parm_error
                cmp cl,points
                jae parm_error
;
;Set the cursor and exit.
;
                xchg ch,cl              ;swap CH and CL
                mov al,points           ;calculate ending scan line
                sub al,cl
                dec al
                cmp ch,al               ;make sure parameters are legal
                ja parm_error
                mov cl,al               ;transfer scan line to CL
                call SetCursorMode      ;set cursor shape
cursor_exit:    mov ax,4C00h            ;exit with ERRORLEVEL = 0
                int 21h
;
;Command line parameters are out of range.  Print error message and exit.
;
parm_error:     mov ah,9                ;print error message
                mov dx,offset errmsg
                int 21h
                mov ax,4C01h            ;exit with ERRORLEVEL = 1
                int 21h
;
;Create the cursor definition screen for interactive mode selection.
;
noparm:
;                mov ah,15               ;get columns and page
;                int 10h
;                mov columns,ah          ;save them
;                mov vpage,bh
                cmp columns,80          ;at least 80 columns displayed?
                jae col80               ;yes, then branch
                mov deltacol,1          ;no, then adjust for short display

col80:          call ClearScreen        ;clear the screen
                mov ah,1                ;hide the cursor
                mov ch,20h
                int 10h

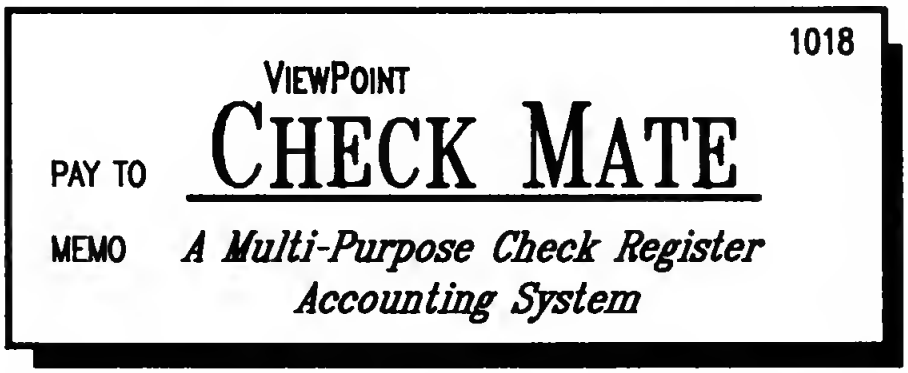
                mov ax,0020h            ;blank the screen header line
                mov bl,attr2
                mov bh,vpage
                mov cl,columns
                xor ch,ch
                int 10h
                mov si,offset header    ;display screen header
                mor dh,dh
                mov dl,columns
                sub dl,37
                shr dl,1
                call WriteString
                call DrawFrame          ;draw the cursor selection frame

                mov ah,2                ;display 'CTYPE /XX' subheader
                mov dh,2
                mov dl,startcol
                mov bl,attr1
                mov si,offset subheader
                call WriteString
;
;Position and display a 2-line underline cursor.
;
                mov cl,points           ;get number of scan lines
                dec cl                  ;decrement it for ending line
                mov ch,cl               ;set starting line one higher
                dec ch                                          (continues)
```

CTYPE.ASM: *The assembly language source code for CTYPE.COM.*

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■ UTILITIES

```
                jmp short display
;
;Enter a loop, polling the keyboard for keypresses.
;
getkey:         mov ah,0                        ;get a keypress
                int 16h
                or al,al                        ;extended code?
                je excode                       ;yes, then branch
                cmp al,32                       ;SPACEBAR?
                jne nospace
                call showText                   ;show cursor with text
                jmp short getkey                ;return for more

nospace:        cmp al,13                       ;ENTER key?
                jne getkey                      ;no, then ignore keypress
                call ClearScreen                ;clear screen and exit
                jmp cursor_exit

excode:         cmp ah,72                       ;Up-arrow?
                jne checklft
                or ch,ch                        ;decrement starting scan line
                jne ex1
                mov ch,cl
                jmp short display
ex1:            dec ch
                jmp short display

checklft:       cmp ah,75                       ;Left-arrow?
                jne checkrt
                inc cl                          ;increment ending scan line
                cmp cl,points
                jne display
                mov cl,ch
                jmp short display

checkrt:        cmp ah,77                       ;Right-arrow?
                jne checkdn
                cmp ch,cl                       ;decrement ending scan line
                jne rt1
                mov cl,points
                dec cl
                jmp short display
rt1:            dec cl
                jmp short display

checkdn:        cmp ah,80                       ;Down-arrow?
                jne getkey                      ;no, then ignore the keypress
                cmp ch,cl                       ;increment starting scan line
                jne dn1
                xor ch,ch
                jmp short display
dn1:            inc ch

display:        call showParm                   ;display command line parameters
                call LocateCursor               ;repositino the cursor
                call SetCursorMode              ;then display it in its new form
                jmp short getkey                ;return to keyboard loop
ctype           endp

;---------------------------------------------------------------------------
;SetVideoParms retrieves and stores the number of rows displayed and the
;number of scan lines per character.
;---------------------------------------------------------------------------
SetVideoParms proc near
                push bx                         ;save BX
                mov ax,1130h                    ;get scan line and row count
                int 10h
                mov rows,dl                     ;save them (rows - 1)
                mov points,cl
                pop bx                          ;restore BX
                ret
SetVidxcPsrms endp

;---------------------------------------------------------------------------
;SetCursorMode sets the shape of the cursor.
;Entry:  CH,CL - beginning and ending scan lines
;---------------------------------------------------------------------------
SetCursorMode proc near
                push cx                         ;save CX for screen location
                cmp adapter,2                   ;is an EGA active?
                jae scm1                        ;no, then branch
                inc cl                          ;yes, then adjust ending line
                cmp cl,points                   ;wrap around if necessary
                jne scm0
                xor cl,cl

scm0:           cmp ch,cl                       ;should this be a block cursor?
                jae scm1                        ;no, then branch
                mov cl,1Eh                      ;yes, then adjust ending scan line

scm1:           push es                         ;save ES
                mov ax,bios_data
                mov es,ax
                assume es:bios_data
                mov dx,addr_6845                ;get CRT Controller address
                mov cursor_mode,cx              ;save definition in BIOS area
                pop es                          ;restore ES
                assume es:code

                mov al,10                       ;OUT CH and CL to cursor registers
                out dx,al
                inc dx
                mov al,ch
                out dx,ai
                dec dx
                mov ai,11
                out dx,ai
                inc dx
                mov ai,cl
                out dx,ai
                pop cx                          ;retrieve nominal cursor shape
                ret
SetCursorMode endp

;---------------------------------------------------------------------------
;ShowTest displays the current cursor on a line of text.
;---------------------------------------------------------------------------
endcol          db ?                            ;ending column

ShowTest        proc near

                push cx                         ;save cursor parameter
                call ClearRegion                ;clear lower part of screen
                mov si,offset footer2           ;display new footer
                mov cx,3
                call DrawFootr
                mov ah,2                        ;home the cursor
                dec dh
                int 10h
                mov endcol,di                   ;calculate rightmost column
                add endcol,27

input:          mov ah,0                        ;get a keystroke
                int 16h
                or al,al                        ;extended code?
                je fkey                         ;yes, then branch

                cmp ai,32                       ;SPACEBAR?
                jne input                       ;no, then ignore it
                call ClearRegion                ;restore main footer
                mov si,offset footer1
                mov cx,4
                call DrawFooter
                pop cx                          ;restore cursor parameter
                call LocateCursor               ;restore cursor position
                ret

fkey:           cmp ah,75                       ;Left-arrow?
                jne fkey1
                cmp di,startcol                 ;at left end of line?
                je input                        ;yes, then don't move
                dec di                          ;move one character left
fkey0:          mov ah,2
                mov bh,vpage
                int 10h
                jmp short input                 ;return for more

fkey1:          cmp ah,77                       ;Right-arrow?
                jne input                       ;no, then ignore it
                cmp dl,endcol                   ;at right end of line?
                ja input                        ;yes, then don't move
                inc di                          ;advance cursor
                jmp short fkey0
ShowTest        endp

;---------------------------------------------------------------------------
;LocateCursor positions the cursor inside the selection frame.
;Entry:  CH,CL - starting and ending cursor scan lines
;---------------------------------------------------------------------------
LocateCursor    proc near
                mov dh,ch                       ;calculate screen row from CH
                add dh,4
                mov dl,startcol                 ;calculate column from CL
                add dl,2
                mov al,dxltacol
                add dl,al
                inc al
                mov bl,points
                sub bl,cl
                dec bl
                mul bl
                add dl,al
                mov bh,vpage                    ;set video page number
                mov ah,2                        ;position cursor
                int 10h
                ret
LocateCursor    endp
```

(CTYPE.ASM continues)

■ UTILITIES

```
;-------------------------------------------------------------------------
;ShowParm updates the display of the current cursor's /XX parameters.
;Entry:  CH,CL - starting and ending scan lines
;-------------------------------------------------------------------------
ShowParm        proc near
                mov ah,2                        ;position the cursor
                mov bh,vpage
                mov dh,2
                mov dl,startcol
                add dl,7
                int 10h
                mov ah,08h                      ;write first character
                mov al,ch
                add al,41h
                int 10h
                mov ah,08h                      ;write second character
                mov al,points
                sub al,cl
                add al,48h
                int 10h
                ret
ShowParm        endp

;-------------------------------------------------------------------------
;DrawFrame draws the cursor definition frame.
;-------------------------------------------------------------------------
numpoints       dw ?                            ;counter for dots per line
;
DrawFrame       proc near
                mov al,points                   ;calculate length of top line
                mov bl,deltacol
                inc bl
                mul bl
                add ax,3
                mov cx,ax                       ;transfer result to CX
                mov bl,columns                  ;calculate starting column number
                sub bl,al
                shr bl,1
                mov startcol,bl

                mov ah,2                        ;position cursor for top line
                mov dh,3
                mov dl,startcol
                mov bh,vpage
                int 10h
                mov ax,0920h                    ;blank out the top line
                mov bl,attr2
                int 10h

                mov cx,lpoints                  ;fill in text of top line
                mov dh,3
                mov dl,startcol
                add dl,deltacol
                add dl,2
                mov al,'A'
drawloop1:      mov bl,al
                mov ah,2
                int 10h
                mov ah,9Eh
                mov al,bl
                int 10h
                add dl,deltacol
                inc dl
                mov al,bl
                inc al
                loop drawloop1

                mov cx,lpoints                  ;then blank the vertical leg
                mov dh,4
                mov dl,startcol
                mov bl,attr2
drawloop2:      push cx
                mov ah,2
                int 10h
                mov ax,0920h
                mov cl,deltacol
                inc al
                xor ch,ch
                int 10h
                inc dh
                pop cx
                loop drawloop2

                mov cx,lpoints                  ;fill in the dots and text
                mov numpoints,cx
                mov dh,4
                mov dl,startcol
                inc dl
                mov al,'A'
drawloop3:      push cx
                mov bl,al
                mov ah,2
                int 10h
                mov al,bl
                mov ah,9Eh
                int 10h
                mov cx,numpoints                ;fill one grid line
wloop4:         mov ah,2
                add dl,deltacol
                inc dl
                int 10h
                mov ax,09F9h
                int 10h
                loop drawlonp4

                dec numpoints                   ;one less dot on next line
                mov al,bl
                inc al
                inc dh
                mov dl,startcol
                inc dl
                pop cx
                loop drawloop3

                mov textrow,dh                  ;store current row number
                inc textrow
                mov si,offset footer1           ;draw text footer
                mov cx,4
                call DrawFooter
                ret
DrawFrame       endp

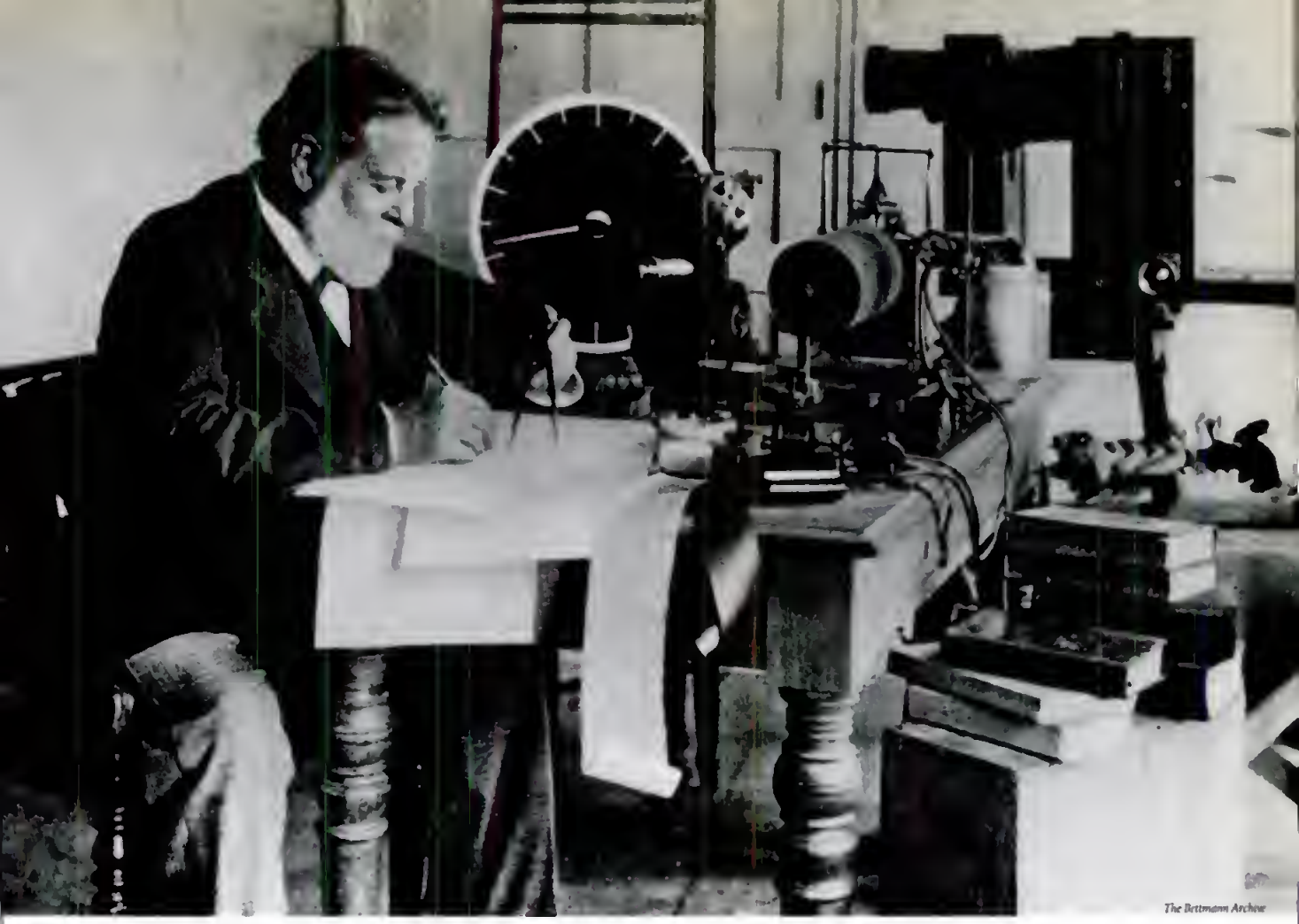
;-------------------------------------------------------------------------
;DrawFooter writes a block of text below the selection frame.
;Entry:  CX - number of lines
;-------------------------------------------------------------------------
DrawFooter      proc near
                mov dh,textrow                  ;initialize cursor position
                mov dl,startcol
                mov bl,attr1                    ;set attribute
drawloop5:      push cx                         ;enter loop
                call WriteStrlog                ;write one line
                inc dh                          ;advance cursor
                mov dl,startcol
                pop cx
                loop drawloop5                  ;loop until done
                ret
DrawFooter      endp

;-------------------------------------------------------------------------
;WriteString writes an ASCIIZ text string to video memory.
;Entry:  DS:SI - string address
;        DS,DL - starting cursor address
;        BL    - attribute
;-------------------------------------------------------------------------
WriteString     proc near
                mov ah,2                        ;position cursor
                mov bh,vpage
                int 10h
                lodsb                           ;get a byte
                or al,al                        ;is it the delimiter?
                js wsl                          ;yes, then exit
                mov ah,9                        ;no, then display it
                mov cx,1
                int 10h
                inc dl                          ;advance the cursor
                jmp short WriteString           ;loop until done
wsl:            ret
WriteString     endp

;-------------------------------------------------------------------------
;ClearScreen clears the display and homes the cursor.
;-------------------------------------------------------------------------
ClearScreen     proc near
                mov ah,2                        ;home the cursor
                xor dx,dx
                mov bh,vpage
                int 10h
                xor cx,cx                       ;define upper right corner
clear1:         mov dl,cnlumns                  ;define lower right corner
                dec dl
                mov dh,rows
                mov bh,old_attr
                mov ax,0600h                    ;video function 6
                int 10h                         ;clear region
                ret
ClearScreen     endp

;-------------------------------------------------------------------------
;ClearRegion clears the lower portion of the display.
;-------------------------------------------------------------------------
ClearRegion     proc near
                mov ch,textrow                  ;define upper left corner
                xor cl,cl
                jmp short clear1
ClearRegion     endp
;
code            ends
                end begin
```

(CTYPE.ASM ends)



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■ UTILITIES

```
100 REM -- BASIC PROGRAM TO CREATE CTYPE.COM
110 OPEN "CTYPE.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 5
160 FOR I = 1 TO  157
150    LINESUM = 0
155    PRINT ".";
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
265    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 15 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 121506 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,    43,     1,    67,    86,    89,    80,    69,   666
300 DATA     32,    49,    46,    48,    32,    48,    99,    41,   387
310 DATA     32,    49,    57,    56,    55,    32,    90,   105,   476
320 DATA    102,   102,    32,    67,   111,   109,   159,   117,   749
330 DATA    110,   105,    95,    57,   116,   105,   111,   110,   853
340 DATA    115,    32,    87,   111,    46,    26,    74,   101,   572
355 DATA    102,   102,    32,    50,   116,   111,   115,   105,   761
360 DATA    115,   101,    88,    67,    32,    77,    97,   103,   672
375 DATA     57,   122,   105,   110,   151,    32,    67,   117,   751
385 DATA    114,   115,   111,   114,    32,    68,   101,   102,   757
390 DATA    105,   110,   105,   116,   105,   111,   110,    32,   754
600 DATA     85,   116,   105,   100,   105,   116,   121,     0,   758
610 DATA     67,    84,    89,    80,    69,    32,    47,     0,   460
425 DATA     68,    32,    85,   115,   101,    32,    97,   114,   636
430 DATA    114,   111,   115,    32,   107,   101,   121,   115,   820
440 DATA     32,   116,   111,    32,   115,    97,   110,   105,   721
450 DATA    103,    97,   116,   101,    32,   103,   114,   105,   771
460 DATA    100,    32,    62,     0,     0,    69,    78,    54,   625
470 DATA     69,    82,    32,    32,    32,    32,    58,    32,   369
480 DATA     83,   101,   100,   101,    55,   116,    32,    99,   735
495 DATA    117,   116,   115,   111,   114,    32,    57,   110,   810
500 DATA    100,    32,   101,   120,   105,   116,     0,    83,   657
510 DATA     88,    65,    67,    69,    66,    65,    52,    32,   526
520 DATA     50,    32,    86,   105,   101,   115,    32,    99,   632
530 DATA    117,   114,   115,   111,   114,    32,   119,   105,   827
540 DATA    116,   104,    32,   116,   101,   120,   116,     5,   705
550 DATA     65,    32,    55,   114,   101,   115,   115,    32,   665
560 DATA     83,    80,    65,    67,    65,    66,    65,    82,   577
570 DATA     32,   116,   111,    32,   114,   101,   116,   117,   739
580 DATA    114,   115,    32,    62,     0,     0,    65,    32,   615
590 DATA    115,   105,   110,   103,   100,   101,    32,   105,   702
600 DATA    155,   110,   101,    32,   111,   102,    32,   1.5,   788
610 DATA     97,   109,   112,   100,   101,    32,   116,   101,   776
620 DATA    120,   116,     0,    13,    15,    73,   105,   105,   560
630 DATA    101,   103,    97,   100,    32,   112,    57,   116,   764
640 DATA     57,   109,   101,   110,   101,   114,   115,    13,   766
650 DATA     10,    36,     3,     0,     5,    24,     0,     2,    53
660 DATA     31,     0,     2,     0,     0,     0,   100,    15,   220
670 DATA    205,    16,   136,    30,    35,     2,   136,    62,   633
680 DATA     66,     2,   100,     0,   205,    16,   136,    30,   629
690 DATA     41,     2,   104,    66,     5,   142,   192,   104,   809
700 DATA      0,    26,   255,    16,    60,    26,   117,    25,   670
710 DATA    128,   251,     7,   114,    15,   125,   251,     0,   902
720 DATA    119,    10,   232,    91,     1,   120,   251,     7,   839
730 DATA    116,    56,   235,    66,   256,    14,    34,     2,   775
740 DATA    100,    10,   179,    16,   205,    16,   120,   251,   553
755 DATA     16,   116,    17,    30,   246,     6,   135,     0,   574
760 DATA      5,   117,     5,   232,    50,     1,    10,   255,   650
770 DATA    117,    24,   235,    32,   254,    14,    34,     2,   712
780 DATA     30,   247,     6,    99,     0,    64,     0,   117,   571
790 DATA     15,   195,     6,    35,     2,    14,   254,    14,   542
800 DATA     36,     2,   190,     6,    39,     2,     7,   190,   486
810 DATA      6,    40,     2,   112,    14,     7,   252,   191,   624
820 DATA    130,     5,   125,   125,   254,     2,   116,    86,   819
830 DATA    155,    10,     5,   176,    47,   242,   174,   227,  1061
840 DATA     57,   139,    13,   125,   225,   223,   223,   129,  1130
850 DATA    233,    65,    65,    50,    46,    35,     2,   115,   619
860 DATA     29,    50,    14,    35,     2,   115,    23,   134,   418
870 DATA    233,   165,    35,     2,    42,   153,   254,   200,  1119
880 DATA     50,   232,   119,    10,   135,   250,   232,   231,  1220
890 DATA      5,   104,     0,    76,   205,    33,   100,     9,   687
905 DATA    106,    11,     2,   255,    33,   104,     1,    76,   698
910 DATA    205,    33,   120,    62,    30,     2,    80,   115,   663
920 DATA      5,   190,     6,    42,     2,     1,   232,   191,   677
930 DATA      2,   100,     1,   101,    32,   205,    16,   106,   881
540 DATA     32,     5,   130,    30,    40,     2,   130,    62,   451
555 DATA     44,     2,   130,    16,    35,     2,    50,   237,   525
960 DATA    205,    16,   190,    50,     1,    50,   246,   135,   984
```

(continues)

CTYPE.BAS: *A BASIC program that will automatically create CTYPE.COM.*

to the CRT controller's cursor registers.

This was a straightforward process until the EGA was introduced. Both the EGA and the VGA implement a custom CRT controller similar to the 6845. To retain some degree of compatibility with older adapters, the EGA designers arranged the array of CRT controller registers in a manner almost identical to the 6845. The cursor registers are located again at 10 and 11 and are accessed through the same manipulations of the Address Register and Data Register that were required with the CGA and MDA. Thus, a programmer can deal directly with the hardware cursor registers without having to identify the adapter first.

A problem arises, however, because of the EGA's different interpretation of the ending scan line. With a CGA, MDA, or VGA (which handles the cursor very much like its predecessors), setting the cursor to scan lines 6 and 7 (the seventh and eighth scan lines, respectively—the first scan line is numbered zero) meant writing a 6 and 7 to the cursor registers. On an EGA, you must write the value of the ending scan line plus 1. Thus, if there are 8 scan lines per character, the cursor registers are set to 6 and 0 to obtain the standard two-line underline cursor.

You can create a block cursor on a CGA by specifying starting and ending values of 0 and 7; it's 0 and 13 on an MDA. It follows that an EGA would require a value of 0 and 0. Not so. Like the other video adapters, the EGA leaves you with a single scan-line cursor if the starting line and ending line are the same. To produce a block cursor when using the EGA, you give the ending line an "out-of-range" value of 1Eh.

The VGA behaves much like a CGA, even though its design isn't based on the 6845. Starting and ending scan lines are interpreted the same way, and the cursor registers are located at the same addresses. Setting the starting scan line greater than the ending scan line, however, destroys the cursor. The VGA alone actually prohibits a wraparound cursor.

A BUG IN THE BIOS When dealing directly with the hardware becomes prohibitively complex, it's usually wise to turn to the built-in BIOS functions for help. The video BIOS provides a convenient function for setting the cursor shape that worked fine with the first generation of adapters. Unfortunately, this source of ready assistance has proved unreliable with the EGA. The reason constitutes a classic tale of good intentions rendered useless by poor execution.

Before the days of the EGA, applications commonly defined their own cursor shape by checking to see whether they were running on a CGA or an MDA, setting values for the starting and ending scan lines accordingly, and either calling interrupt 10h or writing to the 6845 to initialize a cursor. So that existing programs would

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980 DATA  232, 124,   2, 232, 121,   1, 180,   2,  984
990 DATA  182,   2, 130,  22,  43,   2, 130,  20,  557
1000 DATA  39,   2, 190,  96,   1, 232, 183,   2,  665
1010 DATA 130,  14,  35,   2, 254, 201, 130, 233, 1015
1020 DATA 254, 205, 235,  97, 180,   0, 205,  22, 1190
1030 DATA  18, 192, 116,  19,  60,  32, 117,   5,  551
1040 DATA 232, 160,   0, 235, 239,  60,  12, 117, 1064
1050 DATA 235, 232,  92,   2, 233, 122, 255, 120, 1299
1060 DATA 252,  72, 117,  12,  10, 237, 117,   4,  821
1070 DATA 130, 233, 235,  57, 254, 205, 235,  53, 1410
1080 DATA 120, 252,  75, 117,  12, 254, 193,  50, 1089
1090 DATA  14,  35,   2, 117,  40, 120, 205, 235,  786
1100 DATA  34, 120, 252,  77, 117,  16,  50, 233,  917
1110 DATA 117,   0, 120,  14,  35,   2, 254, 201,  769
1120 DATA 235,  19, 254, 201, 235,  15, 120, 252, 1339
1130 DATA  60, 117, 169,  50, 233, 117,   4,  50,  828
1140 DATA 237, 225,   2, 254, 197, 222, 210,   0, 1375
1150 DATA 232, 175,   0, 232,  10,   0, 225, 140, 1040
1160 DATA  83, 104,  40,  17, 205,  16, 134,  22,  711
1170 DATA  37,   2, 136,  14,  35,   2,  91, 195,  512
1180 DATA  81, 120,  62,  34,   2,   2, 117,  16,  442
1190 DATA 254, 193,  50,  14,  35,   2, 117,   2,  675
1200 DATA  50, 201,  50, 233, 117,   2, 177,  30,  868
1210 DATA   4, 104,  64,   0, 142, 192,  30, 139,  745
1220 DATA  22,  99,   0,  30, 137,  14,  96,   0,  486
1230 DATA   7, 176,  10, 230,  66, 130, 197, 230, 1070
1240 DATA  74, 176,  11, 230,  66, 130, 193, 230, 1134
1250 DATA  89, 195,   0,  81, 232, 217,   1, 190, 1005
1260 DATA 200,   1, 105,   3,   0, 232, 125,   1,  755
1270 DATA 100,   2, 254, 206, 205,  16, 136,  22, 1021
1280 DATA   2,   4, 120,   6,   2,   4,  27, 100,  353
1290 DATA   0, 205,  22,  10, 192, 116,  21,  60,  626
1300 DATA  32, 117, 244, 232, 170,   1, 190, 104, 1000
1310 DATA   1, 105,   4,   0, 232,  86,   1,  80,  500
1320 DATA 232,  39,   0, 195, 120, 252,  75, 117, 1030
1330 DATA  10,  50,  22,  42,   2, 116, 216, 254,  729
1340 DATA 202, 100,   2, 130,  62,  44,   2, 205,  835
1350 DATA  16, 235, 204, 120, 252,  77, 117, 199, 1220
1360 DATA  50,  22,   2,   4, 116, 193, 254, 194,  843
1370 DATA 235, 231, 130, 245, 120, 190,   4, 130, 1317
1380 DATA  22,  43,   2, 120, 194,   2, 160,  42,  593
1390 DATA   2,   2, 200, 254, 192, 130,  30,  35,  841
1400 DATA   2,  42, 217, 254, 203, 246, 227,   2, 1193
1410 DATA 200, 130,  42,  44,   2, 100,   2, 205,  841

1420 DATA  16, 195, 100,   2, 130,  62,  44,   2,  639
1430 DATA 102,   2, 130,  22,  43,   2, 120, 194,  711
1440 DATA   7, 205,  16, 100,  14, 130, 197,   4,  761
1450 DATA  65, 205,  16, 100,  14, 160,  35,   2,  677
1460 DATA  42, 193,   4,  64, 205,  16, 195,   0,  719
1470 DATA   0, 160,  35,   2, 130,  30,  42,   2,  489
1480 DATA 254, 195, 246, 227,   5,   3,   0, 139, 1069
1490 DATA 200, 130,  30,  30,   2,  42, 216, 200,  874
1500 DATA 235, 136,  30,  43,   2, 100,   2, 102,  810
1510 DATA   3, 130,  22,  43,   2, 130,  62,  44,  452
1520 DATA   2, 205,  16, 104,  32,   9, 130,  30,  616
1530 DATA  40,   2, 205,  16, 139,  14,  25,   2,  453
1540 DATA 102,   2, 130,  22,  43,   2,   2,  22,  414
1550 DATA  42,   2, 120, 194,   2, 176,  65, 130,  747
1560 DATA 216, 100,   2, 205,  16, 100,  14, 130,  951
1570 DATA 195, 205,  16,   2,  22,  42,   2, 254,  738
1580 DATA 194, 130, 195, 254, 192, 226, 222, 129, 1570
1590 DATA  14,  25,   2, 102,   4, 130,  22,  43,  440
1600 DATA   2, 130,  30,  40,   2,  81, 100,   2,  475
1610 DATA 205,  16, 104,  32,   9, 130,  14,  42,  640
1620 DATA   2, 254, 193,  50, 237, 205,  16, 254, 1211
1630 DATA 190,  89, 226, 233, 139,  14,  35,   2,  936
1640 DATA 137,  14, 175,   4, 102,   4, 130,  22,  676
1650 DATA  43,   2, 254, 194, 176,  65,  81, 130,  953
1660 DATA 216, 100,   2, 205,  16, 130, 195, 100, 1132
1670 DATA  14, 205,  16, 139,  14, 175,   4, 100,  747
1680 DATA   2,   2,  22,  42,   2, 254, 194, 205,  723
1690 DATA  16, 104, 249,  14, 205,  16, 226, 239, 1149
1700 DATA 255,  14, 175,   4, 130, 195, 254, 192, 1227
1710 DATA 254, 190, 130,  22,  43,   2, 254, 194, 1105
1720 DATA  89, 226, 203, 136,  54,  45,   2, 254, 1009
1730 DATA   6,  45,   2, 190, 104,   1, 105,   4,  537
1740 DATA   0, 232,   1,   0, 105, 130,  54,  45,  665
1750 DATA   2, 130,  22,  43,   2, 130,  30,  30,  414
1760 DATA   2,  81, 232,  10,   0, 254, 190, 130,  915
1770 DATA  22,  43,   2,  89, 226, 243, 195, 100, 1000
1780 DATA   2, 130,  62,  44,   2, 205,  16, 172,  641
1790 DATA  10, 192, 116,  11, 100,   9, 105,   1,  704
1800 DATA   0, 205,  16, 254, 104, 235, 232, 195, 1331
1810 DATA 100,   2,  51, 210, 130,  62,  44,   2,  609
1820 DATA 205,  16,  51, 201, 130,  22,  30,   2,  673
1830 DATA 254, 202, 130,  54,  37,   2, 130,  62,  807
1840 DATA  41,   2, 104,   0,   6, 205,  16, 195,  449
1850 DATA 130,  46,  45,   2,  50, 201, 235, 220,  945
```

(CTYPE.BAS ends)

not have to be rewritten for the EGA, the writers of the EGA BIOS included cursor emulation logic in their code. These cursor emulation routines checked the values of CH and CL when the cursor mode function was called and made adjustments as necessary to fit the cursor to a 14-scan-line block. An application designed to create an underline cursor on the CGA with scan lines of 6 and 7 works quite well on an EGA because the values are transparently remapped to 11 and 12 before being sent on to the CRT controller.

But there are two flaws in the emulation logic. The first and more serious is that the new BIOS assumed that an EGA connected to an enhanced color display would always have 14 scan lines per character box. Yet the EGA supports programmable modes, including the popular 43-line mode that uses only eight scan lines per character. Thus, a call to set the cursor to scan lines 6 and 7 in 43-line mode destroys the cursor because the BIOS routines blindly intercept it and erroneously increase the values beyond the bounds of the true number of scan lines. That's one reason why *SideKick* often leaves you without a cursor when it pops down in 43-line mode.

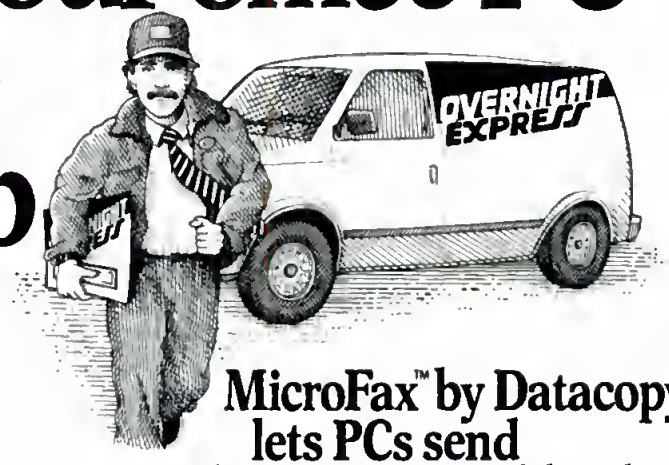
The second flaw in the emulation is that the record of the current cursor mode kept in the BIOS data area reflects the values sent by the calling routine, not those that the BIOS actually sets for the cursor. If there are 14 scan lines per character and the BIOS correctly translates a call for a 6-7 cursor into an 11-12 cursor, it stores away the bytes 6 and 7. Since the cursor registers are write-only, an application that comes along at a later time has no way of determining how the cursor really appears.

Making that determination is critical to a TSR as well as to some transient applications. CTYPE, for example, though not a memory-resident program, is forced to reset the cursor to an underline when it brings up the selection frame simply because it cannot be certain where the cursor's starting and ending scan lines are when it gains control. Nor can it assume that the cursor emulation state (which can be enabled and disabled by toggling bit 0 of the byte at absolute address 0040:0087h) is the same as it was the last time the cursor was set. Thus, while reading the cursor mode from the BIOS data area and following it with a BIOS call to set the same configuration was once a safe and reasonable task, with the advent of the EGA it has become something of a crapshoot. (The VGA BIOS also uses some type of emulation logic, but since this BIOS listing hasn't been published and there is no other documentation that addresses this feature, it can only be treated for now as an unknown quantity.)

Because of this BIOS mess, then, programmers have little choice except to bypass it and go directly to the cursor registers. That's exactly what CTYPE does to provide reliable cursor definition service.

IDENTIFYING ADAPTERS The new VGA adapter adds still another step to the process of identifying the video adapter installed and active in the system at any given moment. Since CTYPE has to treat

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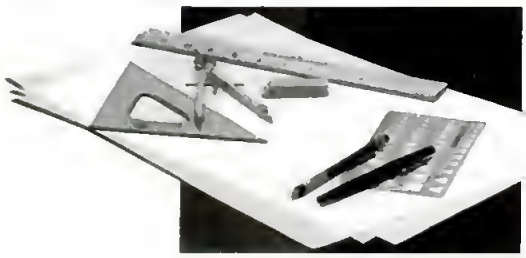
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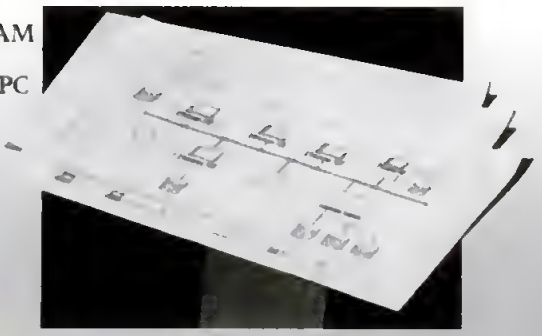
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CTYPE BY MODEM

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If you use the Xmodem protocol, you can download CTYPE .COM directly, saving typing or downloading either the .BAS or the .ASM version. CTYPE.BAS, whether entered at your keyboard or down-loaded from PC-IRS, will automatically create CTYPE-.COM when run once in BASIC. CTYPE.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM CTYPE;
LINK CTYPE;
EXE2BIN CTYPE CTYPE.COM
```

Photocopy this page. Trim and hole-punch the copy and add it to your DOS manual.

CTYPE Command

Jeff Prosise — 1987/No. 19 (Utilities)

Purpose: Recovers the cursor when it disappears upon leaving an applicarion and permits setting cursor shape.

Format: `[d:][\path]CTYPE [/xy]`

Remarks: The optional */xy* command line parameter, which can also be used in an AUTOEXEC.BAT file, consists of two letters ranging from A to the letter that represents the maximum number of scan lines in the current video mode characrer box. This is N for an MGA or an EGA in 25-line mode (14 scan lines), and H for an EGA in 43-line mode or a CGA in text mode (eight scan lines).

Entered withour rhe */xy* paramerer, CTYPE brings up a selection frame in which, as the cursor is moved by the arrow keys, the cursor size/shape changes. Pressing the Spacebar ar this poinr alternately shows the cursor against a sample line of text and returns to the selector frame. Pressing Enter selects the cursor shape shown and returns to the command line prompt.

When the cursor is remporarily losr, as when exiting from *SideKick* (or other TSR utility) while in a 43-line EGA mode, enrering CTYPE will restore the cursor.

Note: Many applications programs reset the cursor internally for their own purposes. These settings will supersede those of CTYPE. To restore the CTYPE cursor on exit, run such programs from a batch file whose last line resets the desired CTYPE paramerers.

■ UTILITIES

EGA cursor definitions in a special way to accommodate the hardware's different handling of the cursor registers, it has to know what kind of adapter it is dealing with before it can determine how to correctly handle the cursor.

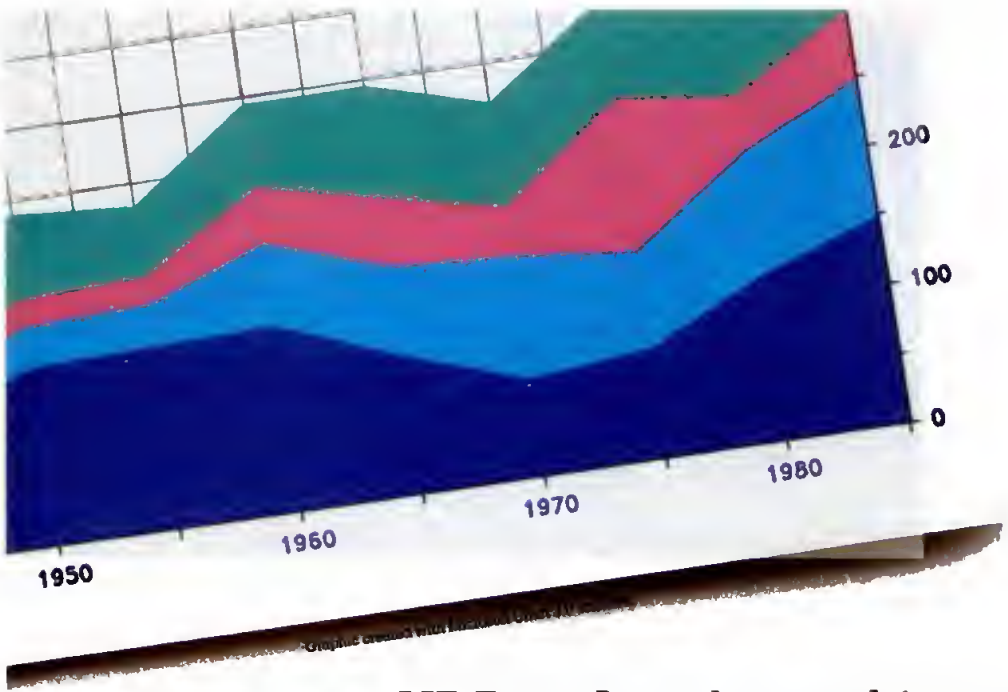
The BIOS of the IBM Personal System/2 machines retains all of the interrupt 10h video functions of its predecessors and appends a few of its own. Function 1Ah returns a display code that reveals, with certain limitations, what kind of video hardware is installed. If calling interrupt 10h with AH set to 1Ah and AL set to 0 returns a 0 in AL, it means that the function is not supported and, by inference, that there's no VGA. If AL comes back as 1, BL contains the display code. A display code of 7 means that a VGA is installed, active, and connected to an analog monochrome display. A display code of 8 signals the calling routine that a VGA is linked to an analog color monitor. Like the EGA, a VGA can coreside with other video adapters and can thus be present in the system, yet not be active at the time of detection.

CTYPE uses this scheme to sniff around for a VGA. If it doesn't find one,

■ CTYPE has to know the kind of adapter before it can determine how to handle the cursor.

CTYPE then uses the method recommended in IBM's *Personal System/2* and *Personal Computer BIOS Interface Technical Reference* to hunt for an EGA. Interrupt 10h is called with AH equal to 12h and BL set to 10h. If this function returns BL unchanged, then it is unsupported and an EGA cannot be present in the system. If an EGA is detected, the EGA Information Byte at offset 87h in the BIOS data area (this is the same byte that holds the cursor emulation status bit) must be consulted to determine whether the EGA is currently active or has yielded control to another adapter. If bit 3 is clear, the EGA is active; a 1 means it's not. CTYPE looks at the base address of the CRT controller at offset 63h (a word) to reveal whether the EGA is connected to a color or monochrome monitor. Alternatively, it could read bit 1 of the EGA Information Byte for the same information.

When both the VGA and the EGA tests fail, CTYPE assumes it must be dealing with either a CGA or an MDA. The CRT controller base address provides the answer, just as it reveals whether an EGA is running in monochrome or color. The 6845 Address Register is mapped into port



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address 3D4h for a CGA and into 3B4h for an MDA, a difference of one bit. CTYPE tests the single bit with a TEST instruction and proceeds onward armed with the video information it needs.

IN CLOSING Many applications (*1-2-3*, for one) take control of the cursor when they run, and naturally their procedure takes precedence over the cursor shape you had set before you loaded them. Since CTYPE is not memory resident, its cursor is not automatically restored when you exit such applications. (If you run applications that reset the cursor from a batch file, you could, of course, include a final line with the desired CTYPE parameters.) But the next time your cursor is mysteriously destroyed by a running application or TSR, or when you simply want to reshape the cursor, just enter CTYPE and then you'll be all set.

If you want to investigate the EGA BIOS further, the assembly language listing is contained in the *EGA Technical Reference*, which is available directly from IBM. The phone number for ordering it and other IBM publications is (800) IBM-PCTB, and at last check, the going price for the EGA documentation was a modest $9.95. Inside it you'll see other tricks of the trade in EGA programming, such as how the cursor mode function also provides an emulation for blanking the CGA/MDA cursor by setting the value of the starting scan line to 1Eh.

■ With the PS/2, IBM's tradition of publishing BIOS listings has apparently been discontinued.

The VGA documentation is included in the *Personal System/2 Technical Reference*, but as I indicated previously, don't expect to see its BIOS listing there. With the PS/2 series, IBM's long-standing and generous tradition of publishing the BIOS listings for its machines has apparently been discontinued, perhaps because of the code's complexity and perhaps because such openness makes a clone maker's job that much easier.

In this Utilities column I demonstrated the problems of setting cursor shapes. In the next issue, I'll show how to create a utility that fixes the bug in the EGA cursor routine and allows you to maintain your chosen cursor shape throughout your applications. PC

Jeff Prosise is a contributing editor of PC Magazine.

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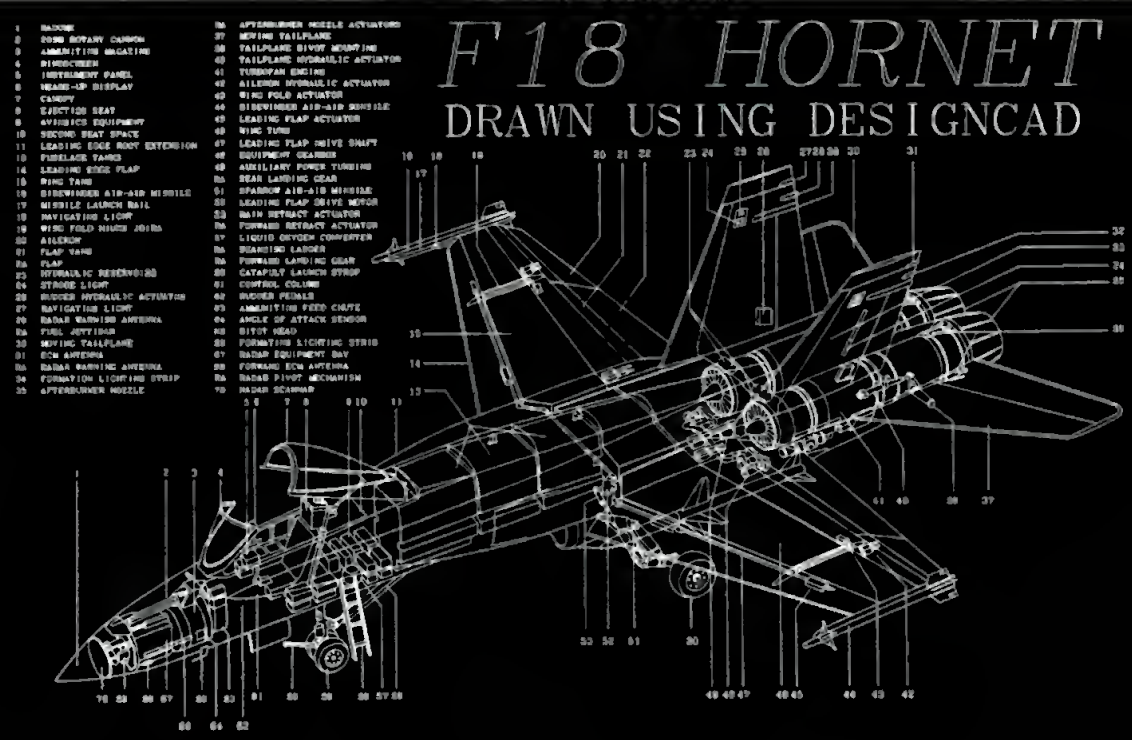
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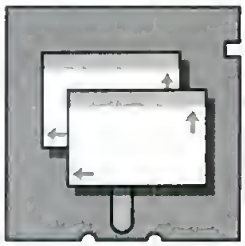
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■ ENVIRONMENTS ■ CHARLES PETZOLD

OS/2 KERNEL PROGRAMMING



The Kernel is the OS/2 component common to all OS/2 systems. In this issue I'll present a few short working OS/2 Kernel programs to help you get the feel of the new environment.

OS/2 will ultimately incorporate two very different environments within one operating system. The initial version of OS/2 (expected to be available at retail in the first quarter of 1988) will contain only one of these—the Kernel component, which is the part of OS/2 that will be common to all OS/2 systems.

Although the OS/2 Kernel provides all the file support, multitasking, and interprocess communication facilities of OS/2, it's not much to look at. The user interface is essentially the same as the MS-DOS command line. And, as we'll see, programs written to run under the OS/2 Kernel are quite similar in structure to programs written for MS-DOS and other traditional operating systems.

Sometime late in 1988 (the third quarter perhaps), OS/2, Version 1.1 will arrive. OS/2 1.1 will include the second environment—the Windows Presentation Manager, which is now generally referred to simply as the Presentation Manager, or PM. The Presentation Manager is a graphics-based windowing environment that is largely derived from *Microsoft Windows*. To the user, the OS/2 Presentation Manager will look and act very much like *Microsoft Windows* 2.0, which is an update of the original *Windows* 1.0*x*.

The OS/2 Kernel and Presentation Manager manage multitasked programs in two different ways. The Kernel allows multiple programs to run by giving them different "screen groups." Each screen group is a separate virtual screen. The user can flip among different screen groups (and, hence, among different programs) from the keyboard. The OS/2 Presentation Manager runs in one of these screen groups. The Presentation Manager allows multiple programs to run in one screen group by dividing the screen into various windows.

Thus, under OS/2 1.1 you will have:

- one screen group running the Presentation Manager, with various programs running in windows under the Presentation Manager;
- one DOS-compatibility mode screen group (provided by the OS/2 Kernel) that runs programs written for the old DOS 2.*x* and 3.*x* environments; and
- multiple screen groups running various programs written for the OS/2 Kernel.

THE BIG DECISION A programmer who wants to write an OS/2 program must begin by deciding whether to write the program for the OS/2 Kernel or the OS/2 Presentation Manager. These are two very different environments from both the user's and programmer's perspectives.

■ It's very likely that most of the early OS/2 applications will be OS/2 Kernel programs that have been converted from MS-DOS programs.

In a few years all new applications programs will probably be written for the Presentation Manager (or whatever it evolves into). The Presentation Manager has many functions that allow programmers to incorporate graphics, menus, dialog boxes, and other aspects of the *Windows*-type (and Macintosh-type) user interface into their programs. This consistent user interface is a great help to users.

On the other hand, programmers who have been working with *Windows* have found it a difficult system to learn, and the Presentation Manager will not be any easier. Unlike the traditional structure of programs written for MS-DOS and the OS/2 Kernel, Presentation Manager programs are structured to receive various messages from the operating system and act upon them.

It's very likely that most of the early OS/2 applications will be OS/2 Kernel programs that have been converted from existing MS-DOS programs. This is a fairly simple process for most character-mode programs. The programmer begins by separating code and data segments and by making a few other changes (such as getting rid of segment arithmetic) so the program doesn't violate rules of protected mode. All the software interrupts (such as Interrupt 21h) and hardware accesses must then be replaced with equivalent OS/2 function calls. I suspect we'll start seeing these converted programs around the same time that retail versions of OS/2 1.0 become available.

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Similarly, programs written for the MS-DOS version of *Windows* should be convertible to the OS/2 Presentation Manager. Microsoft has promised to make tools available to ease this conversion. (The original promise was that no conversion at all would be necessary.) Again, you should start seeing these converted programs about the same time that OS/2 1.1 hits the stores.

Non-*Windows* DOS programs that make extensive use of graphics are the most problematic cases. The OS/2 Kernel is not a hospitable environment for graphics applications. For anything other than CGA graphics, the program must directly access the hardware of the video display adapter. Normally this would be forbidden in a multitasking, protected-mode environment. But OS/2 is designed as an open system. Programs *can* access the video hardware, but they must make certain provisions to save and restore the video display state when the user switches between screen groups. The OS/2 Presentation Manager is an excellent environment for graphics, but converting a non-*Windows* DOS program to a Presentation Manager program is not a trivial job.

AN EASY DECISION FOR NOW For the next few months we'll explore only the OS/2 Kernel, thus saving the Presentation Manager for later columns. There are several reasons for this:

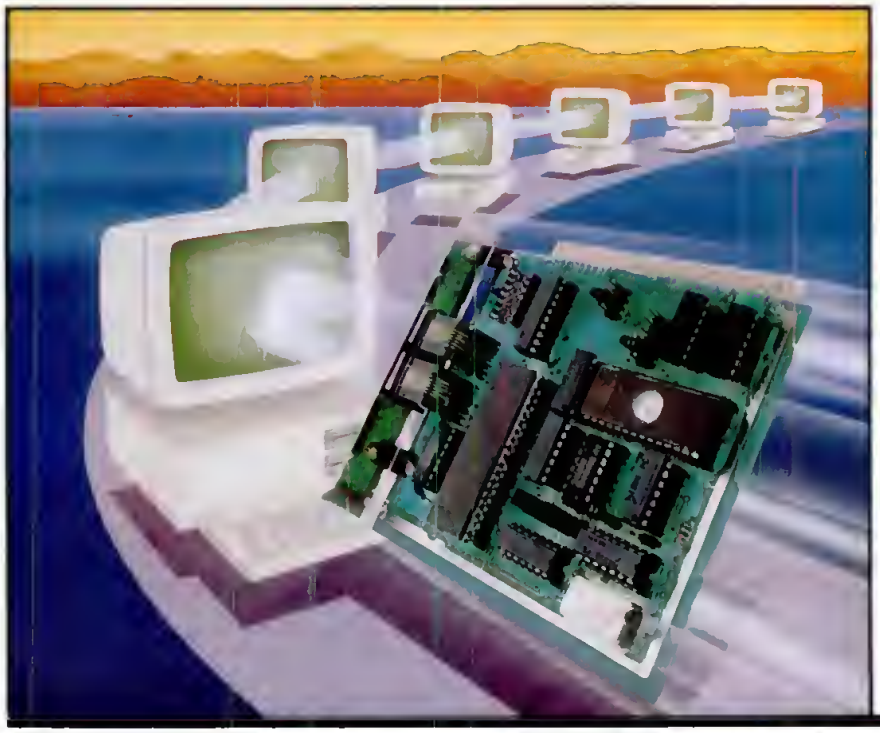
- At the time I write this (late July), those of us who invested $3,000 in Microsoft's OS/2 Software Development Kit have not yet seen even *specifications* for the Windows Presentation Manager. (These specifications are expected in August.) A functional version of the Presentation Manager is not expected until the end of this year.
- Programmers interested in the concepts and structure of OS/2 Presentation Manager programs have already had almost 2 years to learn a very similar system by programming for the MS-DOS version of *Microsoft Windows*. It's been obvious for quite some time that *Windows* was a preview of OS/2.
- OS/2 Kernel programming is very easy compared with Presentation Manager programming. It's a good place to start looking at OS/2.

Warning: The programs I'll be present-

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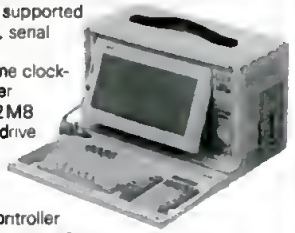
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■ ENVIRONMENTS

ing here (and in several future Environments columns) are based on the *beta-level version* of OS/2 and on various programming tools distributed with the initial release of the OS/2 Software Development Kit. By the time the OS/2 Kernel is released in retail versions in early 1988 (and more reasonably priced development kits become available), some details may have changed.

MASM 5.0 TO THE RESCUE Most of the MS-DOS assembly language programs that have appeared in *PC Magazine* were written to use the .COM file format. The .COM format has certain advantages over the alternative .EXE format. Among other things, .COM files are smaller than .EXE files, and the programmer doesn't have to worry about defining separate segments for the code, data, and stack. Everything in the program is in one segment.

■ A .COM file violates one of the basic tenets of protected mode: the separation of code and data segments.

But OS/2 does not support the .COM file format (except, of course, in the DOS compatibility screen group). A .COM file violates one of the basic tenets of protected mode: the separation of code and data into separate segments. This separation must be reflected in assembly language programs.

Fortunately, Microsoft's MASM 5.0 comes to the rescue. Although MASM 5.0 is not yet available, an early beta version (called MASM 4.5) is included in the OS/2 Software Development Kit. One of the new features added to MASM is called "simplified segment definitions."

Basically you begin by putting the directive DOSSEG at the top of your .ASM file. Then you specify the memory model. The example assembly language programs in this column use the small memory mod-

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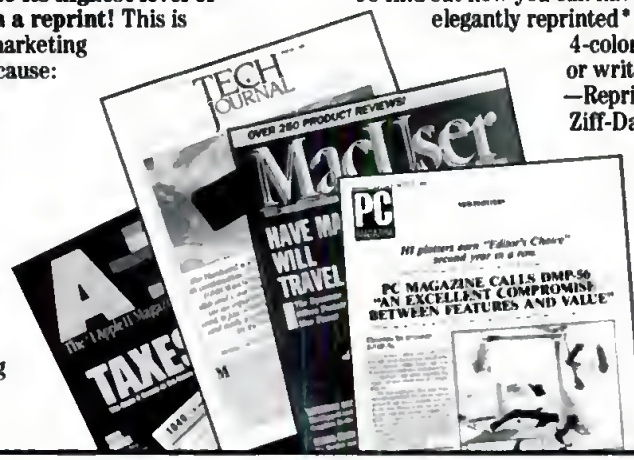
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el (one code segment and one data segment). This requires the directive

```
.MODEL SMALL
```

Then you can use the following directives to preface various parts of the program:

```
.CODE       Code segment
.DATA       Initialized data
.DATA?      Uninitialized data
.CONST      Constant data
.STACK      Stack
```

And that's it. MASM assigns default segment names, segment attributes, and group names that are compatible with those used in the Microsoft C, Pascal, and Fortran compilers. This makes it relatively easy to achieve consistency between your assembly language source code files and the compilers.

The DATA, DATA?, CONST, and STACK segments are grouped into one physical segment with a group name of DGROUP. This is the program's "automatic data segment," which is the data segment addressed by the DS and SS segment registers on entry to the program.

The DATA? and STACK segments do not take up space in the .EXE file. The contents of these segments are initialized to zero when the program is loaded into memory. Although OS/2 does not include any facility to protect the contents of the CONST segment, the Microsoft Pascal and Fortran compilers will not allow CONST data to be overwritten.

For programs that require more than 64K for code or data, MASM 4.5 also recognizes the .FARDATA and .FARDATA? directives to create additional data segments. You can also create additional code segments by assigning the segments different names.

THE SIMPLEST OS/2 PROGRAM

With these preliminaries out of the way, the first OS/2 Kernel program we'll look at is the simplest OS/2 program possible. The NOTHING.ASM program shown in Figure 1 simply calls the OS/2 function that exits a program.

The DOSEXIT function is similar to the MS-DOS interrupt 21h function call 4Ch. DOSEXIT must be treated within the program as an external far function, so it must be declared as such at the top of the

```
; NOTHING.ASM -- Do-Nothing Assembly Language Program for OS/2
; ------------------------------------------------------------

        EXTRN DOSEXIT:FAR           ; Tell MASM about external OS/2 function

        DOSSEG                      ; Normal segment ordering and grouping
        .286                        ; Allow 80286 instructions
        .MODEL  SMALL               ; 1 code segment, 1 data segment

        .STACK  200H                ; 512 byte stack (in DGROUP data group)

        .CODE                       ; Start of code segment

Entry:  Push    0                   ; Means end this thread only
        Push    0                   ; Result code
        Call    DOSEXIT             ; Make OS/2 function call

END     Entry                       ; Denotes entry point of program
```

Figure 1: *NOTHING.ASM is the simplest OS/2 assembly language program possible. It calls only the DOSEXIT function.*

listing. The function has two parameters that are pushed on the stack before the function is called. (I described this method of passing parameters to an OS/2 function in the last Environments column.) The .286 directive is included in the .ASM file to allow the 80286 instructions for pushing immediate values directly on the stack.

If the first parameter to DOSEXIT is a 0, it tells OS/2 to end only the current thread. If the parameter is a 1, OS/2 will terminate all threads. Threads are different sections of the program that can run simultaneously. Because NOTHING has only one thread, it doesn't matter which this parameter is. The second parameter is the program's return code, which is similar to the return code used in MS-DOS.

Assembling this program to produce a NOTHING.OBJ file is the same in OS/2 as it is in MS-DOS:

```
MASM NOTHING;
```

(Don't try to do this with a pre-4.5 version of MASM, however.) The next step is to run the linker to create NOTHING.EXE. This is a little different than in MS-DOS because it requires that the DOSCALLS .LIB import library be included in the LINK command line:

```
LINK NOTHING, /ALIGN:16, , DOSCALLS;
```

DOSCALLS.LIB is supplied with the OS/2 Software Development Kit. This import library allows LINK (in its OS/2 incarnation) to set up the NOTHING.EXE file to include a reference to the DOSEXIT function. When NOTHING.EXE is loaded into memory to be run, OS/2 performs a dynamic link between the call to DOSEXIT and the actual DOSEXIT function located in OS/2.

The /ALIGN:16 switch is not crucial. This switch tells LINK to align the program's code and data segments within the .EXE file on 16-byte boundaries. By default, LINK aligns segments on 512-byte boundaries. The default value makes for larger .EXE files but facilitates the fast loading of program segments from disk.

The NOTHING.EXE file produced by LINK is in the New Executable Format (a subject that certainly deserves—and will receive—several Environments columns of its own). This format incorporates the existing MS-DOS .EXE format and includes much more information about the program.

Although NOTHING.EXE contains only 9 bytes of code, the NOTHING.EXE file is 225 bytes long. This is typical of small OS/2 assembly language programs. For larger programs, of course, the overhead required by the New Executable Format is not nearly as significant. Here's how the 225 bytes of NOTHING.EXE break down:

- Old .EXE header: 64 bytes
- New .EXE header: 128 bytes
- Code segment and relocation table: 33 bytes.

Because the New Executable includes the old .EXE header at the top of the file, you could at least try to run NOTHING.EXE under DOS 2.*x* or 3.*x* as well as in the OS/2 DOS-compatibility screen group. However, LINK constructs the old .EXE header so it appears to DOS as if the program requires a whole megabyte of memory. DOS therefore displays the message "Program too big to fit in memory." (In an Environments column in the near future, we'll look at ways to link OS/2 programs so they run in both protected mode and real mode or, at the very least, display a more coherent message.)

AUTOMATING WITH .CMD FILES

Many assembly language programmers working under MS-DOS make up a small batch file to automate an assembly and link. You can do something similar under OS/2. Under OS/2, batch files are called "command files" and have the extension .CMD. The OS/2 command file language has been enhanced to do some tricky things with program return codes.

Here's an example. I created a file called A.CMD to do an assembly and link with only a single line:

```
MASM %1; && LINK %1, /ALIGN:16, , DOSCALLS;
```

The NOTHING program is assembled and linked with the command:

```
A NOTHING
```

The LINK command following the two ampersands will be run only if MASM has a return code of 0, which means that no errors were encountered by MASM during the assembly.

I can confidently predict that about a month after OS/2 1.0 is released, Paul Somerson's User-to-User mailbox will be overflowing with OS/2 command file tricks.

ADDING TEXT AND SOUND Now let's look at an OS/2 Kernel program that actually does something. The VICTORY.ASM program shown in Figure 2 plays the opening eight notes of Beethoven's Fifth Symphony, punctuated in the middle with a display of the text "Protected-Mode Victorious!"

VICTORY calls three OS/2 functions: DOSEXIT, DOSBEEP (which I discussed in detail in last issue's Environments col-

■ ENVIRONMENTS

```
; VICTORY.ASM -- Text and Sound Output in OS/2
; --------------------------------------------

        EXTRN DOSSEEP:PAR, DOSEXIT:PAR, VIOWRTTTY:PAR

        DOSSEG
        .286
        .MODEL  SMALL
        .STACK  200H

        .DATA                           ; Start of initialized data

DUR8TH  equ     200                     ; Duration of 8th note in milliseconds

Notes1  dw      3 dup (659, DUR8TH), 523, 4 * DUR8TH
Notes2  dw      3 dup (587, DUR8TH), 494, 4 * DUR8TH

Text    db      'Protected-Mode Victorious!'
TextLen equ     $ - Text

        .CODE                           ; Start of code segment

Entry:  Mov     SI, Offset Notes1               ; Address of notes and durations
        Mov     CX, 4                           ; Number of notes and durations
        Call    PlayIt

        Push    DS                      ; Segment of Text string
        Push    Offset Text             ; Offset of Text string
        Push    TextLen                 ; Length of Text string
        Push    0                       ; Video Handle (0 for Kernel)
        Call    VIOWRTTTY               ; OS/2 function call

        Mov     SI, Offset Notes2               ; Address of notes and durations
        Mov     CX, 4                           ; Number of notes and durations
        Call    PlayIt

        Push    0                       ; End this thread
        Push    0                       ; Result code
        Call    DOSEXIT                 ; OS/2 function call

PlayIt: Lodsw
        Push    AX                      ; Frequency in Hertz
        Lodsw
        Push    AX                      ; Duration in milliseconds
        Call    DOSSEEP                 ; OS/2 function call
        Loop    PlayIt                  ; Do it CX times
        Ret

END     Entry
```

Figure 2: *VICTORY.ASM demonstrates some simple uses of OS/2 video display and sound generation functions.*

umn), and VIOWRTTTY.

VIOWRTTTY is the simplest OS/2 video I/O (or VIO) function. It treats the display as a teletype by writing the text at the current cursor position and by incrementing the cursor beyond the text after it's done. VIOWRTTTY recognizes the ASCII carriage-return, line-feed, backspace, tab, and bell characters as well as ANSI control sequences.

The first parameter to VIOWRTTTY is a far address (that is, a segment and offset address) of the text string to be displayed. Notice that DS is pushed on the stack before the offset address of the function. The second parameter to VIOWRTTTY is the length of the string. The third parameter is a "video handle," which under the OS/2 Kernel must be set to zero. I'll be discussing video I/O functions in more depth in a future Environments column.

VICTORY can be assembled and linked using the A.CMD command file shown earlier. When VICTORY.EXE is run on the OS/2 command line, it plays the first four notes of the Fifth Symphony, displays the string, and then plays the second four notes. It exits and returns control back to the OS/2 prompt.

As an alternative, you can run VICTORY using the OS/2 DETACH command, thus:

```
DETACH VICTORY
```

OS/2 first tells you the "Process Identification Number" of VICTORY, and the OS/2 prompt then appears. The program runs—and the music plays—in the background; that is, while the music is playing you will be able to move on to some other program.

■ Background processes have a special video I/O function to gain control of the screen if they need it.

The OS/2 DETACH command is similar to the use of the ampersand following a command line in UNIX. Under UNIX, however, a background process can continue to write to the video display. This sometimes results in a real mess on the screen. OS/2 inhibits video output of background processes so they don't interfere with the foreground process. Background processes instead have a special VIO function called VIOPOPUP to gain control of the screen if they need it.

VICTORY IN C In OS/2 you use the same function calls in programs written in assembly language and high-level languages. Regardless of the language, the function call is always treated as a far intersegment call, so, apart from the normal inefficiency of compilers, there's no real penalty for making OS/2 function calls in high-level languages.

Figure 3 shows VICTORY written in C. Notice that the two header files DOSCALLS.H and SUBCALLS.H are included at the top of the program. These provide function declarations of all the OS/2 function calls available to an applications program.

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ENVIRONMENTS

```
/* VICTORY.C -- Text and Sound Output in OS/2 (C Version) */

#include <doscalls.h>
#include <subcalls.h>

#define DUR8TH 288

main ()
          {
          static unsigned int notes [2][4][2] =
                    { 659, DUR8TH, 659, DUR8TH, 659, DUR8TH, 523, 4 * DUR8TH,
                      587, DUR8TH, 587, DUR8TH, 587, DUR8TH, 494, 4 * DUR8TH } ;
          static char text [] = "Protected-Mode Victorious!" ;

          playit (notes [0], 4) ;

          VIOWRTTTY (text, sizeof text - 1, 0) ;

          playit (notes [1], 4) ;
          }

playit (notes, num)
          unsigned int notes [4][2] ;
          int num ;
          {
          int i ;

          for (i = 0 ; i < num ; i++)
                    DOSBEEP (notes [i][0], notes [i][1]) ;
          }
```

Figure 3: *VICTORY.C is the C version of the VICTORY.ASM program shown in Figure 2.*

Using the C compiler provided with the OS/2 Software Development Kit, the VICTORY.C program can be compiled and linked to create an .EXE file by simply executing the command

```
CL VICTORY.C
```

For the more general case, the -Zp compiler switch is sometimes required when making OS/2 function calls from a C program. This switch "packs" structures so that structure fields are aligned on byte boundaries rather than word boundaries. OS/2 structures (often used for passing information between a program and OS/2) are always packed. In addition, the -G2 switch can be used when compiling OS/2 programs to allow the compiler to generate 80286 code.

Charles Petzold is a contributing editor of PC Magazine.

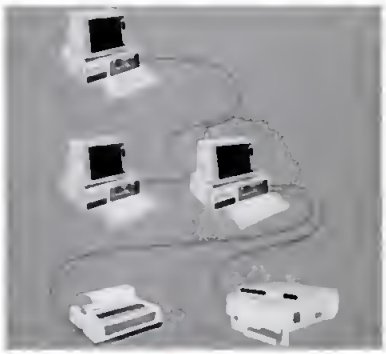
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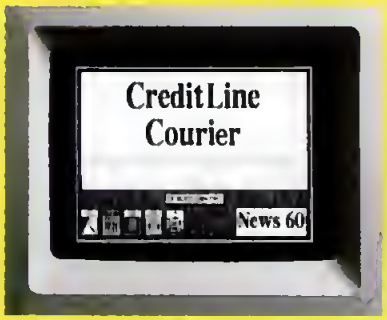
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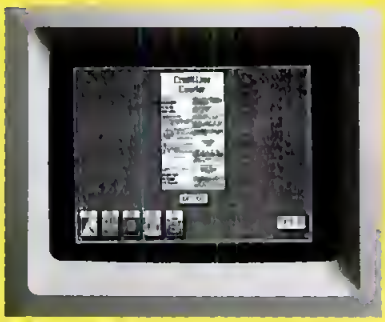
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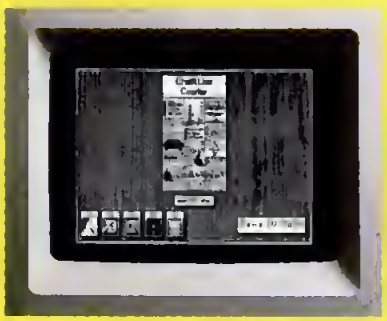
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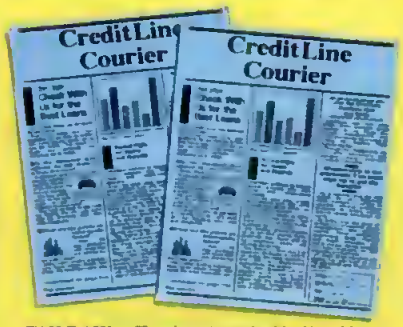
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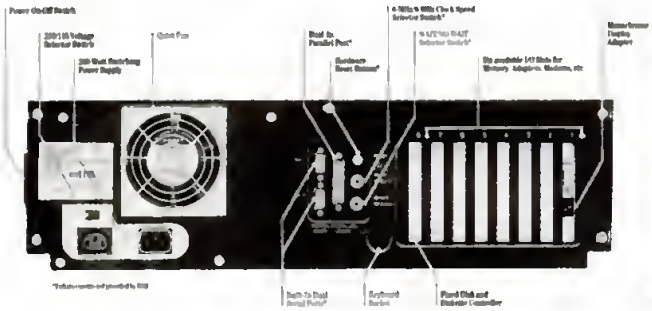
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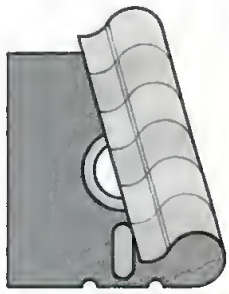
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CIRCLE 250 ON READER SERVICE CARD

■ JARED TAYLOR

SPREADSHEET CLINIC



A timely message from a busy PC; a DOS reminder that 1-2-3 is in the background; a little-known, versatile SuperCalc command; sorting spreadsheets with multirow entries.

SEARCH AND RETURN

There are times when you want to leave the current cell in *1-2-3*, browse the spreadsheet to look at some distant data, and then return. The problem is that *1-2-3* gives you no easy way to get back where you were before. Here's a solution that doesn't require a macro: Start the Copy command with /C and hit Enter. Now you can move all around the spreadsheet and look at anything you like. Just don't hit Enter and complete the copy operation. When you're ready to return, hit Esc and you'll end up right where you started. To get out of the Copy command, hit Ctrl-Break or the Esc key twice.

Nick Masque
Fork Union, Virginia

In this column there have been macros that mark your spot and take you back. Mr. Masque's solution is quick and easy, and I always like solutions that don't require a macro. However, the macro solutions have one advantage. They let you move, edit, or copy anything you like while you're off browsing. The /C solution is for your eyes only.

REMEMBER TO EXIT

Many new spreadsheet programs, such as *Silk* and Release 2 of *1-2-3*, have a very helpful feature that lets you exit temporarily to DOS while the program and your work stay loaded. When you finish, the program reminds you that all you need to do is type EXIT <Enter> in order to return to the spreadsheet.

That reminder soon scrolls off the screen, however, and after you have done some DOS work or run another program, it's easy to forget that you are still running your spreadsheet. I have unintentionally loaded two copies of *1-2-3* simultaneously and then been surprised at how little memory I had available.

To solve this problem, I have rewritten the original batch file, through which I call *1-2-3*, to the one in Figure 1. It now changes the DOS prompt so that if you exit *1-2-3* temporarily with the /System command, the prompt will include the reminder that EXIT will return you to *1-2-3*. Since the batch file is still running when you leave *1-2-3* for good, the last line of the batch file restores a more conventional prompt that indicates your current directory. The file assumes that *1-2-3* is in a directory called \LOTUS, but you could, of course, change it to whatever you use.

Chase Davis
Olympia, Washington

This is a good idea that should work with any program, spreadsheet or otherwise, that lets you temporarily exit to DOS. I wouldn't change the prompt to include the entire "Type EXIT . . ." message, though. Just a word or two would be enough of a reminder.

Switching to a longer prompt adds material to your environment. If you already have a lot in there, the new prompt string could push you over DOS's normal 160-byte limit. You can expand the environment space available when you boot up by using the /E switch with the DOS SHELL command in Versions 3.2 and 3.3.

Each copy of COMMAND that is loaded receives a copy of the current environment. In versions of DOS prior to 3.0, the size of the environment copy is limited to the size of the original. So if the environment is full when you start 1-2-3, *you will not be able to add to it. Beginning with DOS 3.0, this restriction no longer applies.*

SUSPENDING SUPERCALC MACROS

I would like to call your readers' attention to a particularly useful *SuperCalc 4* macro command that is not well explained in the manual. It is the {suspend} command, which temporarily stops macro execution to let the user enter data or use the spreadsheet in any other way. F8 restarts the macro. This command lets the user do things

```
echo off
prompt (Type Exit and press [RETURN] to return to 1-2-3) $p$g
cd\lotus
123
cd\
prompt $p$g
```

Figure 1: *A handy DOS batch file that will remind you that you still have* 1-2-3 *loaded when you exit to the system.*



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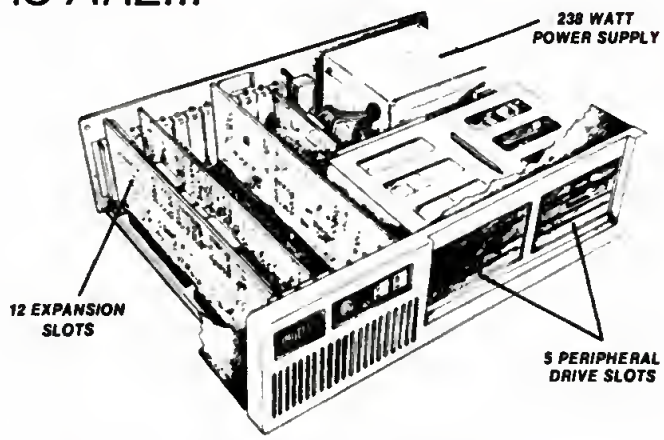
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■ SPREADSHEET CLINIC

not provided for in the macro. Examples would be entering printer setup strings and choosing plotting resolutions and fonts. You can do this with macros and menus, but there might be too many choices to handle them all conveniently.

Craig Israelsen
College Station, Texas

This is indeed a useful macro command, and I wish more spreadsheets had it. The SuperCalc *manual explains it in only three lines, so many users may skip right over it. The best use for it I know of is to temporarily suspend a macro to allow data entry. In most macro languages that allow user input, the macro takes off again as soon as you hit Enter. With {suspend} a user could enter whole columns of data before restarting the macro. Better yet, he could correct mistakes before he started up again.*

Other spreadsheets achieve the suspension effect by using more than one macro. The first ends with a message that when the user wants to continue, he should hit Alt-whatever, to start up the continuation macro.

However, I think one of the best uses for {suspend} is in debugging macros. It lets you put break points in your script that let you stop and check for errors. To restart, just hit F8, which is much *easier than inserting temporary start-up points in a long macro.*

SPREADSHEET AT WORK

Many of our office *1-2-3* routines require lengthy calculations. If the computer is going to be tied up for 20 or 30 minutes, it's useful for the user to know about it so he can go away and do something else. I have therefore written a short routine that puts up a screen telling the user that the spreadsheet is working and that he should come back at a certain time (Figure 2). The cell that displays the time (in this case, 4:11 P.M.) has the range name TIME and contains the formula included in the figure. In this case, TIME will display the current system time plus 45 minutes. You should edit the numbers within the @timevalue function so that they reflect the amount of time the long routine will take.

The macro that calls up this screen is in Figure 3. It sends the cursor to a range named MESSAGE, so as to display Figure 2 properly. It then updates TIME by "editing" it, changes the indicator to BUSY, and turns off screen updates. The time-consuming routine then begins, and restores the indicator and screen updates when it finishes.

```
      WORKING!



COME BACK AT ABOUT

       04:11 PM     <== "TIME"

                    = @NOW+@TIMEVALUE("00:45:00")
```

Figure 2: *A "Working" screen that indicates when a lengthy routine will finish.*

```
\Z        {goto}MESSAGE~
          {goto}TIME~{edit}~
          {indicate BUSY}{paneloff}{windowsoff}
           . . . long
             macro
           here . . .
```

Figure 3: *A macro routine to put up a "working" message.*

Louis Shimbart
Willowdale, Ontario
Canada

It's very useful for the user to know if his computer is going to be out of action for a while, and this is a good, simple way to let him know. I would change only one thing. Instead of going to TIME and updating it with a false edit, substitute this for the second line:

{recalc TIME}

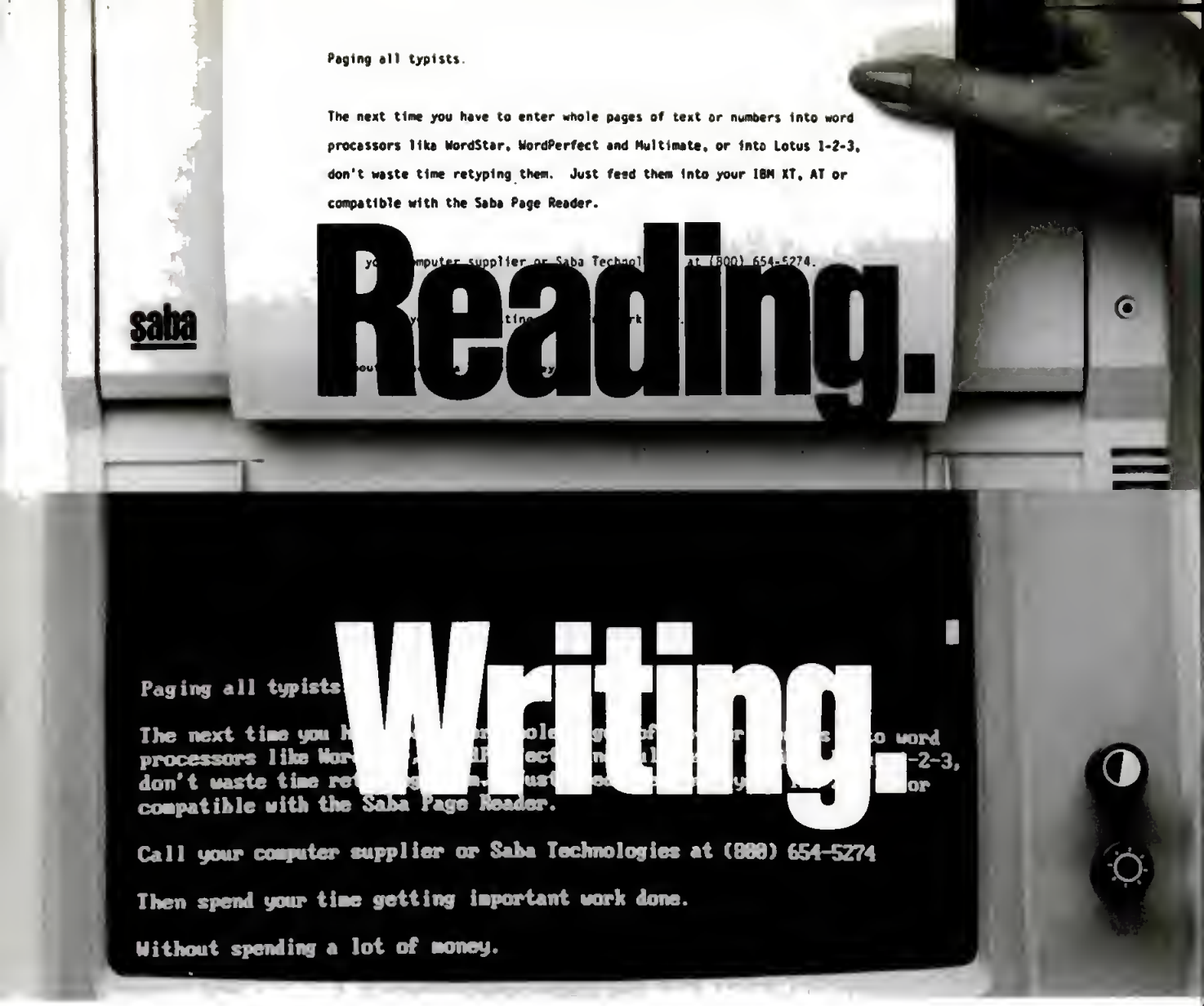
DIFFICULT SORTS

Every now and then you find that you have to sort spreadsheet data of the kind represented in Figure 4 below. Unfortunately, if you would like to sort the items by the Val-

	B	C	D	E	F
7	Item #	Description	Value		
8					
9	3182	Apples, Oranges, Peaches		175	
10		Pears, Plums	$175	175	
11	3200	Apples, Oranges	$110	110	
12	3215	Apples, Oranges, Pears,		215	
13		Peaches, Plums, Bananas,		215	
14		Pineapples, Cherries	$215	215	

```
\A        {goto}e9~
          @if(+d9>0,+d9,+e10)~
          /ce9~e10.e14~
          {calc}
          /rve9.e14~e9~
          /dff9.f14~1~~~
          /dsdb9.f14~pe9~a~sf9~a~g
```

Figure 4: *A technique for sorting multirow entries.*



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■ SPREADSHEET CLINIC

ue figure in Column D, you're in big trouble. Since some of the descriptions are longer than the width of column C, they take up more than one row. This leaves blanks in Column D, so if you sort by that column, all of the blanks will sort together and mess up your data.

I have a solution that will work in any spreadsheet that can fill data and sort by more than one key. For purposes of illustration, I have used *1-2-3* notation.

1. Set aside two columns to the right of your data, in this case columns E and F. (E would be blank to begin with.)

2. In cell E9 simply enter the following formula:

```
@if(+d9>0,+d9,+e10)
```

3. Copy that formula down as far as you want to sort data. You may then need to recalculate the spreadsheet. (Figure 4 shows the results at this stage.)

4. Turn the formulas into values. (In Release 2 of *1-2-3*, you can do this conversion easily enough with the /Range Values command.)

5. In Column F, use /Data Fill to enter an ascending sequence of numbers down the length of the data area.

6. Sort the data using Column E as the primary sort key and Column F as the secondary sort key.

Your worksheet will now fall into place, sorted by value. If you prefer to use a macro, macro \A will do all these steps automatically.

You can now delete the numbers in Columns E and F if you want to. However, if you ever need to put your data back in its original order, the easiest way is to re-sort on Column F.

Randy Mohr
Omaha, Nebraska

The more you use simple sorts, the more you discover what they can't do. This is a good solution to an occasional problem.

In past issues we have looked at how to sort by more than the maximum number of sort keys and how to shuffle in a blank line between every data record. All solutions use the trick of adding additional columns of ordered data to sort on. Mr. Mohr's formula that writes the values in column E is a very nice touch.

Jared Taylor is West Coast editor of PC Magazine.

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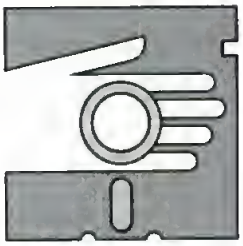
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■ PAUL SOMERSON

USER-TO-USER



Snoop around inside your disk drives, intercept and prevent Ctrl-Alt-Del reboots, and make it a snap to revise and reset your current PATH.

DRIVE SPECS

The DRVST.COM program created by the DRVST.ASM assembly listing in Figure 1 or the BASIC DRVST.BAS program in Figure 2 reports the characteristics and status of the default drive or that of any other selected drive in your system.

DRVST reports the number of bytes per sector, sectors per cluster, total clusters, total bytes capacity on drive, minimum bytes required for each file, available clusters, and available bytes on the drive. It obtains this information from DOS Current Drive service 19h and DOS Drive Free Space service 36h. The syntax for this utility is DRVST [d:].

John D. Haluska
El Segundo, California

```
;DRVST displays the bytes/sector, sectors/cluster, total clusters, total
;bytes, cluster size, available clusters and available bytes for the default
;or selected drive.

CSEG            SEGMENT PARA 'CODE'
                ASSUME  CS:CSEG
MAIN            PROC    FAR
                ORG     100H
START:          JMP     BEGIN

MSG         DB    13,10,'    Characteristics/status of drive
DRIVE       DB    3 DUP(0),13,10,10
BYTESSEC    DB    9 DUP(0),' bytes per sector',13,10
SECCLUS     DB    9 DUP(0),' sectors per cluster',13,10
TOTCLUS     DB    9 DUP(0),' total clusters',13,10
TOTBYTE     DB    9 DUP(0),' total bytes capacity on drive',13,10
BYTECLUS    DB    9 DUP(0),' bytes minimum required for each file',13,10,10
AVAILCLUS   DB    9 DUP(0),' available clusters',13,10
AVAILBYTE   DB    9 DUP(0),' available bytes on drive',13,10,10
            DB    '     FORMAT: DRVST [d:]',13,10,'$'

ERRMSG      DB    'Invalid drive!',13,10,'$'

BEGIN:      MOV     SI,5C0          ;ADDRESS OF SELECTED DRIVE
            MOV     AL,[SI]         ;DRIVE: 0=DEFAULT, 1=A, ETC
            PUSH    AX              ;SAVE DRIVE NUMBER
            CMP     AL,0            ;DEFAULT DRIVE?
            JNE     AAA             ;NO
            MOV     AH,19H          ;CALL DOS CURRENT DRIVE SERVICE
            INT     21H             ;  REPORTS DRIVE: 0=A, 1=B, ETC
            INC     AL              ;MAKE DRIVE: 1=A, 2=B, ETC

AAA:        ADD     AL,64           ;CONVERT TO ASCII
            MOV     DI,OFFSET DRIVE
            MOV     [DI],AL         ;STORE DRIVE LETTER

            POP     DX              ;RECALL DRIVE NUMBER
            XOR     DH,DH           ;ZERO REGISTER
            MOV     AH,36H          ;CALL DOS DRIVE
            INT     21H             ;  FREE SPACE SERVICE
            CMP     AX,0FFFFH       ;INVALID DRIVE?
            JE      INVDRV          ;YES
            PUSH    BX              ;SAVE AVAILABLE CLUSTERS FOR AVAILBYTE
            PUSH    CX              ; *   BYTES/SECTOR        *     *
            PUSH    AX              ; *   SECTORS/CLUSTER     *     *
            PUSH    BX              ; *   AVAILABLE CLUSTERS  *  AVAILCLUS
            PUSH    CX              ; *   BYTES/SECTOR        *  BYTECLUS
            PUSH    AX              ; *   SECTORS/CLUSTER     *     *
            PUSH    DX              ; *   TOTAL CLUSTERS      *  TOTBYTE
            PUSH    CX              ; *   BYTES/SECTOR        *     *
            PUSH    AX              ; *   SECTORS/CLUSTER     *     *
            PUSH    DX              ; *   TOTAL CLUSTERS      *  TOTCLUS
            PUSH    AX              ; *   SECTORS/CLUSTER     *     *  SECCLUS
            XOR     DX,DX           ;ZERO REGISTER
            MOV     AX,CX           ;BYTES/SECTOR FOR ASCII CONVERSION
            MOV     DI,OFFSET BYTESSEC+9  ;END OF OUTPUT STRING
            CALL    ASCII
            XOR     DX,DX           ;ZERO REGISTER
            POP     AX              ;RECALL SECTORS/CLUSTER
            MOV     DI,OFFSET SECCLUS+9   ;END OF OUTPUT STRING
            CALL    ASCII
            XOR     DX,DX           ;ZERO REGISTER
            POP     AX              ;RECALL TOTAL CLUSTERS
            MOV     DI,OFFSET TOTCLUS+9   ;END OF OUTPUT STRING
            CALL    ASCII
            POP     AX              ;RECALL SECTORS/CLUSTER
            POP     CX              ;  *    BYTES/SECTOR
            MUL     CX              ;GET BYTES/CLUSTER
            POP     CX              ;RECALL TOTAL CLUSTERS
            MUL     CX              ;GET TOTAL BYTES CAPACITY
            MOV     DI,OFFSET TOTBYTE+9   ;END OF OUTPUT STRING
            CALL    ASCII
            POP     AX              ;RECALL SECTORS/CLUSTER
            POP     CX              ;  *    BYTES/SECTOR
            MUL     CX              ;GET CLUSTER SIZE
            MOV     DI,OFFSET BYTECLUS+9  ;END OF OUTPUT STRING
            CALL    ASCII
            XOR     DX,DX           ;ZERO REGISTER
            POP     AX              ;RECALL AVAILABLE BYTES
            MOV     DI,OFFSET AVAILCLUS+9 ;END OF OUTPUT STRING
            CALL    ASCII
            POP     AX              ;RECALL SECTORS/CLUSTER
            POP     CX              ;  *    BYTES/SECTOR
            MUL     CX              ;GET BYTES/CLUSTER
            POP     CX              ;RECALL AVAILABLE CLUSTERS
            MUL     CX              ;GET AVAILABLE BYTES
            MOV     DI,OFFSET AVAILBYTE+9
            CALL    ASCII
            MOV     DX,OFFSET MSG   ;SEND RESULTS TO DISPLAY
            MOV     AH,9            ;CALL DOS DISPLAY
            INT     21H             ;  STRING SERVICE
            JMP     EXE

INVDRV:     MOV     DX,OFFSET ERRMSG
            MOV     AH,9            ;CALL DOS DISPLAY
            INT     21H             ;  STRING SERVICE

BBB:        INT     20H             ;CALL DOS PROGRAM TERMINATE SERVICE

MAIN        ENDP

ASCII       PROC    NEAR            ;32 BIT BINARY INTEGER NUMBER TO
```

(continues)

Figure 1: *DRVST.ASM listing to create DRVST.COM.*

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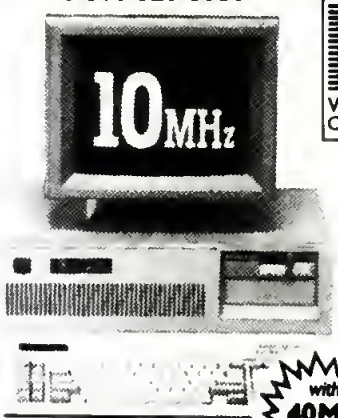
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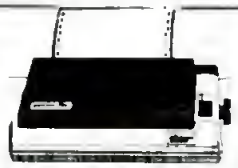
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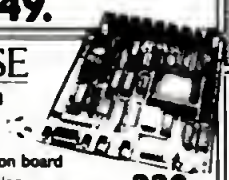
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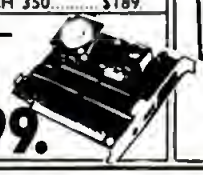
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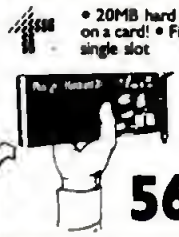
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CIRCLE 528 ON READER SERVICE CARD

■ USER-TO-USER

```
                        ;ASCII,LO WORD IN AX, HI WORD IN DX,
                        ;ASCII OUTPUT PTR (LSD FIRST) IN DI
        XCHG    BP,DX   ;SAVE HIGH WORD IN BP
        MOV     BX,0AH  ;DIVISOR (10) IS BX
        MOV     CL,3BH  ;CONVERSION FOR ASCII IS CL
ASC1:   CMP     BP,0    ;DONE WITH HI WORD?
        JB      ASC2    ;YES
        XCHG    AX,BP   ;HI WORD IN AX, LO WORD IS BP
        XOR     DX,DX   ;CLEAR REGISTER
        DIV     AX      ;DIVIDE HI WORD BY 10
        XCHG    BP,AX   ;NEW HI WORD IS BP, LO WORD IS AX
        DIV     AX      ;DIV LO WORD + HI WORD REMAINDER
        OR      DL,CL   ;CONVERT REMAINDER TO AXCII
        MOV     [DI],DL ;QUOTIENT INTO STORAGE
        DEC     DI      ;STEP BACK ONE BYTE
        JMP     ASC1    ;GO AGAIN
ASC2:   XOR     DX,DX   ;CLEAR REGISTER
        DIV     BX      ;DIV LO WORD BY 10
        OR      DL,CL   ;CONVERT REMAINDER TO ASCII
        MOV     [DI],DL ;QUOTIENT INTO STORAGE
        DEC     DI      ;STEP BACK ONE BYTE
        CMP     AX,0    ;ARE WE DONE?
        JNZ     ASC2    ;NO
        RET             ;YES-EXIT
ASCII   ENDP
CSEG    ENDS
        END     START
```

(Figure 1 ends)

```
100 ' Program for creating DRVST.COM -- John D. Saluska
110 CLS:PRINT "Checking DATA; please wait..."
120 FOR B=1 TO 32:FOR C=1 TO 10:READ A$:TTL=TTL+VAL("&H"+A$):NEXT
130 READ B:IF B=TTL THEN 150
140 PRINT "DATA ERROR IN LINE";B*10+190;" -- REDO":END
150 TTL=0:NEXT:RESTORE
160 OPEN "DRVST.COM" AS #1 LEN=1:FIELD #1,1 AS D$
170 FOR B=1 TO 32:FOR C=1 TO 16:READ A$
180 LSET D$=CHR$(VAL("&O"+A$)):PUT #1:NEXT:READ DUMMY$:NEXT
190 CLOSE:PRINT "DRVST.CDN CREATED"
200 DATA E9,49,01,0D,0A,20,20,20,20,43,68,61,72,61,63,74,1152
210 DATA 65,72,69,73,74,69,63,73,2F,53,74,61,74,75,73,20,1593
220 DATA 6F,66,20,44,72,69,76,65,20,00,00,00,0D,0A,0A,00,816
230 DATA 00,00,00,00,00,00,00,00,20,62,79,74,65,73,20,70,727
240 DATA 65,72,20,73,65,63,74,6F,72,0D,0A,00,00,00,00,00,926
250 DATA 00,00,00,00,20,73,65,63,74,6F,72,73,20,70,65,72,1162
260 DATA 20,63,6C,75,73,74,65,72,0D,0A,00,00,00,30,00,00,825
270 DATA 00,00,00,20,74,6F,74,61,6C,20,63,6C,75,73,74,65,1268
280 DATA 72,73,0D,0A,00,00,00,00,00,00,00,00,00,20,74,6F,511
290 DATA 74,61,6C,20,62,79,74,65,73,20,63,61,70,61,63,69,1545
300 DATA 74,79,20,6F,6E,20,64,72,69,76,65,0D,0A,00,00,00,1003
310 DATA 00,00,00,00,00,00,20,62,79,74,65,73,20,6D,69,6E,939
320 DATA 69,6D,75,6D,20,72,65,71,75,69,72,65,64,20,66,6F,1582
330 DATA 72,20,65,61,63,68,20,66,69,6C,65,0D,0A,0A,00,00,1020
340 DATA 00,00,00,00,00,00,00,20,61,76,61,69,6C,61,62,6C,860
350 DATA 65,20,63,6C,75,73,74,65,72,73,0D,0A,00,00,00,00,1041
360 DATA 00,00,00,00,00,20,61,76,61,69,6C,61,62,6C,65,20,993
370 DATA 62,79,74,65,73,20,6F,6E,20,64,72,69,76,65,0D,0A,1397
380 DATA 0A,20,20,20,20,20,46,6F,72,6D,61,74,3A,20,44,52,1027
390 DATA 56,53,54,20,5B,64,3A,5D,0D,0A,24,49,6E,76,61,6C,1192
400 DATA 69,64,20,44,72,69,76,65,21,0D,0A,24,BE,5C,00,8A,1255
410 DATA 04,50,3C,00,75,06,B4,19,CD,21,FE,C0,04,40,8F,29,1456
420 DATA 01,00,05,5A,32,F6,B4,30,CD,21,3D,FF,FF,74,5E,53,1864
430 DATA 51,50,53,51,50,52,51,50,52,50,33,D2,8B,C1,BF,37,1649
440 DATA 01,E0,52,00,33,D2,50,BF,53,01,E0,49,00,33,D2,50,1593
450 DATA BF,72,01,E0,40,00,58,59,F7,E1,59,F7,E1,BF,0C,01,2144
460 DATA E0,33,00,58,59,F7,E1,BF,B5,01,E0,29,00,33,D2,50,1927
470 DATA BF,E6,01,E0,20,00,58,59,F7,E1,59,F7,E1,BF,04,02,2093
480 DATA E0,13,00,BA,03,01,B4,09,CD,21,EB,00,90,BA,3B,02,1502
490 DATA B4,09,CD,21,CD,20,07,EA,BB,0A,00,B1,38,03,FD,00,1039
500 DATA 74,0F,95,33,D2,F7,F3,95,F7,F3,0A,D1,00,15,4F,EB,2360
510 DATA EC,33,D2,F7,F3,0A,D1,00,15,4F,3D,00,00,75,F2,C3,2057
```

Figure 2: *DRVST.BAS program to create DRVST.COM drive spec reporter.*

Users often confuse sectors, tracks, and clusters. This program should help straighten things out, and it provides some very handy tools DOS left out. It's also useful in showing how wasteful some hard disks (such as 10-meg XTs running under DOS 2.1) can be.

TRAPPING CTRL-ALT-DEL

Most good programs provide some type of protection against inadvertent operator errors. For example, pressing Ctrl-Break in an accounting program could cause it to end before important information has been written to disk. But one action that's difficult to guard against is rebooting with Ctrl-Alt-Del.

Personally, I've always felt that if someone wants to get out of a program that badly, then you should let him. Still, preventing even this drastic action is possible.

Trapping Ctrl-Break is easy, because the address for this routine is kept in low memory. All a program has to do is poke a new address there, which usually points to a return instruction located somewhere in ROM. But Ctrl-Alt-Del is handled entirely by the PC's BIOS, so another approach is needed.

The DEBUG script shown in Figure 3 will create a program that stays resident and intercepts keyboard interrupt 9. Once NOBOOT has been loaded, it will receive

```
N NOBOOT.CDN
A
JMP  0139          ;JMP INITIALIZE
DW   0
DW   0
STI                ;New_INT9 starts here
PUSH AX            ;save registers
PUSH DS
IN   AL,60         ;read the keyboard
CMP  AL,53         ;was it the Del key?
JNE  0132          ;no, CONTINUE old INT 9
MOV  AX,0000       ;prepare to see if any
MOV  DS,AX         ;  shift keys are active
MOV  AL,[0417]     ;get the status byte
TEST AL,08         ;is the Alt key down?
JE   0132          ;no, CONTINUE old INT 9
TEST AL,04         ;is the Ctrl key down?
JZ   0132          ;no, CONTINUE old INT 9
IN   AL,61         ;acknowledge keystroke
MOV  AH,AL         ;  so the key won't be
OR   AL,80         ;  hanging around later
OUT  61,AL         ;  (we're simply going
MOV  AL,AH         ;  to ignore it)
OUT  61,AL
MOV  AL,20
OUT  20,AL
POP  DS            ;restore the registers
POP  AX
IRET               ;all done, return
POP  DS            ;CONTINUE to old INT 9
POP  AX
CS:                ;jump to address held at
JMP  FAR [0102] ;  102 in code seg
MOV  AX,3509       ;INITIALIZE get original
INT  21            ;  INT 9 address
MOV  [0102],BX     ;save it at address 102
MOV  [0104],ES     ;  in our code segment
MOV  DX,0108       ;point INT 9 to our new
MOV  AX,2509       ;  handler at address
INT  21            ;  106 in code segment
MOV  DX,0139       ;last address to save
INT  27            ;terminate resident

RCX
53
W
Q
```

Figure 3: *NOBOOT.SCR script to create NOBOOT.COM, which prevents rebooting a PC with Ctrl-Alt-Del. Type it using a pure ASCII word processor or the DOS COPY CON command. Ignore the text following the semicolons. Hit Enter at the end of each line (especially the last one with the Q), and be sure to leave a blank line before RCX. Then type DEBUG < NOBOOT.SCR to create the program.*

■ USER-TO-USER

control every time a key is pressed. If the key is anything but Ctrl-Alt-Del, then it passes on to the original interrupt 9 handler in ROM. Otherwise, it simply ignores the request and returns.

To create NOBOOT.COM, type the instructions with a pure ASCII word processor (omit the text after the semicolons), or use the DOS COPY CON: command to make a file called NOBOOT.SCR. Then, with NOBOOT.SCR on the same disk as DEBUG, enter

```
DEBUG < NOBOOT.SCR
```

The remarks are shown for clarity and need not be entered, though be sure to include the blank lines above RCX and after Q. When DEBUG finishes, NOBOOT.COM will have been created. Once NOBOOT has been run, it will be impossible to reboot without turning off the power.

Ethan Winer
East Norwalk, Connecticut

Some programs that take over INT 9, such as SideKick, *will steal the interrupt back, so if you want to run NOBOOT with* SideKick, *be sure to load* SideKick *last.*

THE TWOFOLD PATH

PC Magazine (PC Tutor, Volume 6 Number 8) offered elegant but complicated solutions to PATH problems. I too have a large number of directories and drives. But what I need most is the ability to add temporary drives and directories to—and then subtract them from—the current PATH.

A simple way to do this is to create one batch file called PATHADD.BAT that adds to your current PATH:

```
ECHO OFF
SET P1=%PATH%
PATH=%PATH%;%1
```

and then create another called PATHOLD.BAT that restores the original PATH:

```
ECHO OFF
PATH=%P1%
SET P1=
```

For instance, if you want to add C:\BIN to your existing PATH temporarily, all you have to do is type

```
PATHADD C:\BIN
```

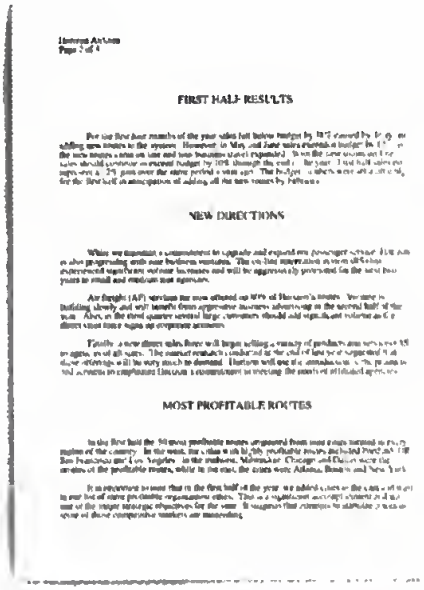
Then, when you're done, to restore things the way they were, just type

```
PATHOLD
```

Roger Swensen
Salt Lake City, Utah

This is indeed a simple and effective technique. PATHADD.BAT simply creates a dummy variable called P1 that stores the contents of the old PATH, and then uses a replaceable parameter to stick a new drive or directory onto the existing PATH. PATHOLD.BAT then takes the original

Maybe it's not what you're saying that's so dull.



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PATH—the one you just stored under the P1 environment variable—and puts things back the way they were, then gets rid of the dummy P1.

The problem with this is that you have to single-step your way through. If you add one directory and later want to get rid of it and add another one, you have to run PATHOLD before you add the second one. If you don't, PATHADD will concatenate the second onto the first.

Another problem is that if your PATH is long, and you haven't expanded your environment or used SUBST to shrink your subdirectory names, you're almost guaranteed to run out of environment space (the default size is a tiny 160 bytes). PC Lab Notes in Volume 6 Number 7 ("Expanding the DOS Environment") explains how to get around this by adding a SHELL command in your CONFIG.SYS file. If you try it, remember that the SHELL command in DOS 3.0 and 3.1 is undocumented and works by specifying extra environment space in 16-byte chunks called paragraphs; in version 3.2 and later it's documented but specifies the actual number of bytes (from 160 to 32,768), not paragraphs.

■ If you haven't expanded your environment or used SUBST, you're almost guaranteed to run out of environment space.

The other way to make your PATHs manageable is with SUBST. If you have a long-winded subdirectory like

C:\FINANCE\PROGRAM\UTILITY

add a SUBST command

```
SUBST E: C:\FINANCE\PROGRAM\UTILITY
```

before your PATH command. Then include the E: in your PATH instead of the C:\FINANCE\PROGRAM\UTILITY. Note that if you try this and want to go past drive E:, you'll want to add a LASTDRIVE command to your CONFIG.SYS file.

Paul Somerson is an executive editor on the staff of PC Magazine.

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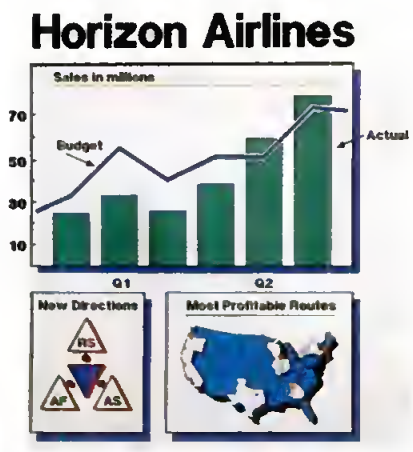
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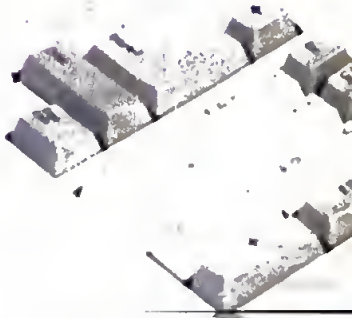
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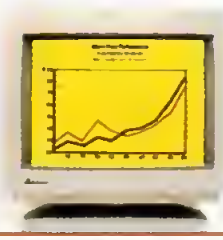
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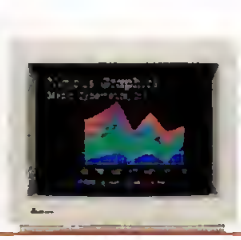
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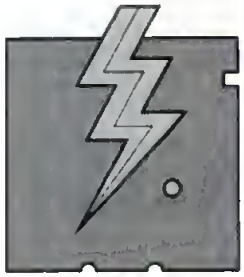


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CIRCLE 373 ON READER SERVICE CARD

■ EDITED BY CRAIG L. STARK



POWER USER

Shifting word processor entries to spreadsheets with SideKick; intelligent directory defaults for Word; changing fields in dBASE; more WordPerfect macros.

MOVING WITH SIDEKICK

Although *SideKick*'s cut-and-paste feature usually makes it easy to transfer data from one program to another, you have a problem if you start out with a list of names and phone numbers in a word processing document and want to transfer the list to a spreadsheet or database. If you load the file into *SideKick*'s notepad, mark the block for pasting (^KB [i.e., Ctrl-KB] for beginning of block, ^KK for end of block, ^KE for paste), then move to your spreadsheet, the full name and phone number for each line wind up in one cell.

To maintain the first name, last name, and phone number each in its own column, you should use your word processor's search-and-replace feature to break each line of the original data into several rows. Simply search for the number of spaces between each field, and replace them with a carriage-return/line-feed combination. Now when you load the file into the notepad, each field will be in its own row, making it easy to paste each field, a line at a time, into your spreadsheet.

Steve Rydgig
Collinsville, Illinois

This is a useful trick, but why bother with a word processing program when you can use SideKick*'s own search-and-replace feature? Load the list of names and phone numbers into the notepad, then hit ^QA (for Quick Alter text).* SideKick *will ask you what to search for and what to replace it with. For the replacement, use ^PJ and ^PM, which will show on the screen as ^J and ^M. If you choose the options G and N, for Global and No confirmation,* SideKick *will quickly run through the entire file. You can then mark the block and use the ^KE command to assign the text to a paste key in line mode.*

—M. David Stone

DIRECTORY DICTATORSHIP

Unless told otherwise, *Microsoft Word* assumes your documents are in the same directory as the program itself. If you keep your documents on another drive, or in some other directory, then each time you load *Word*, you have to tell it the document directory, using the Transfer Options command.

However, if you load *Word* with the /L option (causing *Word* to automatically load your last document), *Word* remembers the directory (and drive) in which that document and its associated style sheet were stored and automatically makes that the default directory. If you don't want to retrieve your last document each time you use *Word*, simply issue the command "Transfer Clear Window" after saving your document but before quitting *Word*. Using the /L option will still set the Transfer directory to your document directory but won't load a file.

Michael Glarbo
New York, New York

■ If you keep your documents in another drive or directory, each time you load *Word*, you have to tell it the document directory.

Using the /L option solves the problem only if you have a single document directory. If you're using a hard disk and have different directories for each project, client, or type of document, you still need a way to designate the right directory when you start Word. *My preference is to use batch files. These take the form*

```
path=c:\word;c:\batfiles
d:
cd \dirname
word %1
```

The first line sets the path to the Word *directory (on drive C:), so you can call up* Word *from anywhere on your system. It also maintains a path to the BATFILES directory, where you should keep all your batch files. The second and third lines log you onto your document directory (and document drive, if necessary). The fourth line calls up* Word, *automatically using the current directory as the default document directory. Notice that the %1 on the last line lets you load* Word *with an option if you like. If you keep your mail in subdirectory LTR, for example, you can create a batch file called LTR.BAT. Now when you type LTR,* Word *will load with LTR as the*

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default directory. But if you type LTR /L, Word will load the last document edited.—M. David Stone

MULTIPLE MACROS

Many *WordPerfect* users like the convenience of Alt-X macros, where X is any alphabetic key. Of course, this limits you to only 26 single-key macros. *WordPerfect* lacks the ability to create complete separate macro libraries that can be invoked to meet special needs.

I have worked around this limitation by using macros to change *WordPerfect*'s default directories. I use five subdirectories for text files: DOC, LEGAL, MISC, IDEAS, and BOOK. In order to save and retrieve files from these subdirectories easily, I have created five Alt-X macros in my *WordPerfect* directory, each of which changes the default to one of my five text subdirectories. A press of F5 then displays the files in the current default instead of requiring that I type in the entire pathname.

An additional benefit to this technique is that *WordPerfect* saves macros on the current directory. It also reads macro files from the current directory when you invoke a macro. [*Not always—see below.—Ed.*] By using my Alt-X macros to change defaults, I can create an additional 26 Alt-X macros in each subdirectory, as well as the 26 in the root. Since I use each subdirectory for a distinct kind of writing, I can create specialized macro libraries for a specific type of work.

■ The only way to clear the macro memory and start fresh in a new directory is to Shell out of *WordPerfect*.

In my root directory I save macros that are common to all my work tasks, such as envelope addressing or mailing labels. By including an Alt-R (for Return to parent directory) macro in each subdirectory, I can invoke the macros in the root after a single keystroke. With two keystrokes I can change the default from any subdirectory to any other.

Here's how to create a macro to change your default directory:

```
<Ctrl-F10>                  Begin macro def.
<Alt-X>                     Press an <Alt>key
<F5>=                       change directory
(full pathname,<Enter>      Enter the new path
<F1>                        Cancel file display
<Ctrl-F10>                  End macro definition
```

To create a macro to return to the parent directory, follow the same steps but type in the name of the parent.

Frank Vehafric
Veneta, Oregon

You can also make a universal macro to return to the parent directory. It works by bringing up the file list, moving one item to the right, and selecting "change directory." In any directory except the root, the item at the top of the right-hand column is "<PARENT>". Put the keystrokes shown in Figure 1 in a macro.

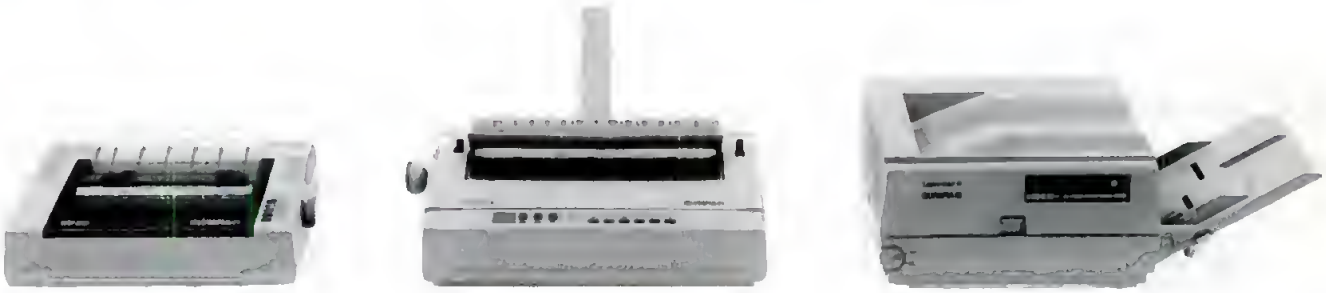
*You might expect to be able to use double-Alt-key macros for quick access to 26*26 different macros. For example, <Alt-M><Alt-C> might switch to the MEDICAL directory and invoke the Alt-C macro in that directory. Unfortunately, an otherwise handy feature of* WordPerfect *becomes a problem here. Once you invoke any macro with the key Alt-C,* WordPerfect *remembers it. The next time that you press Alt-C the program replays the macro from memory, not from disk. Hence, it will never find the other Alt-C macro on the new directory.*

The only way I've found to clear the macro memory and start fresh in a new directory is to Shell out of WordPerfect *and come back. That is, press Ctrl-F1, select 1, and immediately type EXIT. If you are using the* WordPerfect Library, *press Ctrl-*

```
<F5><Enter>          list files
<Right>7<Enter>      Select <PARENT> and change directory to it
<F1><F1>             Cancel the new file display and get out
```

Figure 1: *Neil J. Rubenking's supplement to the Multiple Macro macro.*

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■ POWER USER

F1, select 1, and immediately reselect WordPerfect. *This is not perfect, but it does make multiple 26-letter macro sets possible.*—Neil J. Rubenking

A BETTER PGDN IN DBASE

Here's a simple, nonprogramming technique to use when you want to review and occasionally change the same field in a database. Assume that you're working with field 14 in a database of 29 fields. Every time you move forward to the next record, the cursor pops over to field 1. Repeatedly moving the cursor down to the 14th field all the time is tedious to say the least, so try this instead:

```
SET FUNC 10 TO REPL(CHR(24),29)
```

Now, once you're initially positioned on the 14th field, hitting F10 brings up the next record with the cursor already placed correctly.

I often include a memo field at the bottom of a data entry screen. (Providing a place to scribble seems to alleviate many people's computer paranoia.) If you add +CHR(30) to the above SET FUNC command, a Ctrl-PgDn will be issued after the Down arrows. This has no effect on ordinary fields, but if you are on a memo field, the CHR(30) automatically opens it up for viewing/editing.

Dana Forsberg
Boston, Massachusetts

What goes down must sometimes come up, but it's not so simple to move backward to the previous record and position to the same field. CHR(18) is the PgUp, so if your record fits on one screen, you would

```
SET FUNC 9 TO CHR(18)+REPL(CHR(24),<field#>)
```

A two-screen record is more complicated: you issue either one CHR(18) or two, depending on whether you're on screen 1 or 2 of the record.

If you're still using dBASE III, *which lacks the REPLICATE function, just string the control codes together:*

```
SET FUNC 10 TO CHR(24)+CHR(24)+...
```

The function key will hold up to 30 CHR(24)'s, and the command line can hold up to 264 characters.—Brad Stark

TRANSPOSITION

I very often reverse the order of letters in words (e.g., typing "magaznie" instead of "magazine"). To simplify correcting this error I have created the following *WordPerfect* macro:

```
Ctrl-F10  :   Invoke macro creation
Alt-S     :   Define name of macro
Del       :   Delete character under curaor
Rt Arrow  :   Move right one character
F1        :   Invoke the Undelete function
1         :   Reatore the character
Ctrl-F10  :   End the macro creation
```

To invoke the macro, place the cursor under the first of the transposed letters and press Alt-S. The letters will switch their positions whether you are in Insert or Typeover mode.

Eric S. Feinstein
Forest Hills, New York

You may want to modify Mr. Feinstein's macro to emulate the style of transposition you need most. For example, I'm familiar with an editor that transposes the two characters before the current cursor position, so my Alt-S macro starts with <left><left>.—Neil J. Rubenking

■ Providing a place to scribble seems to alleviate many people's computer paranoia.

Craig L. Stark is senior editor for technical columns of PC Magazine. *M. David Stone and Neil J. Rubenking are contributing editors of* PC Magazine. *Brad Stark is a dBASE programmer and consultant based in Scituate, Massachusetts.*

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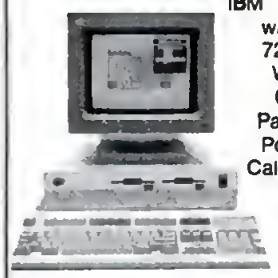
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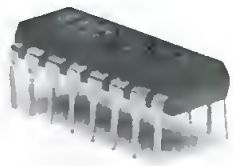
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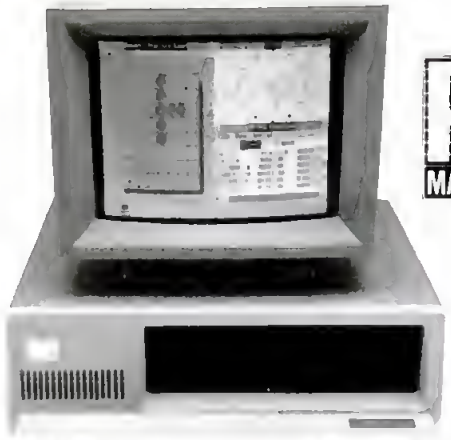
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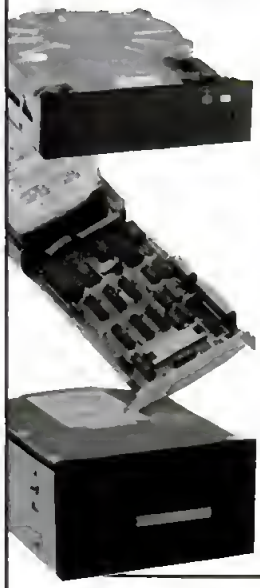
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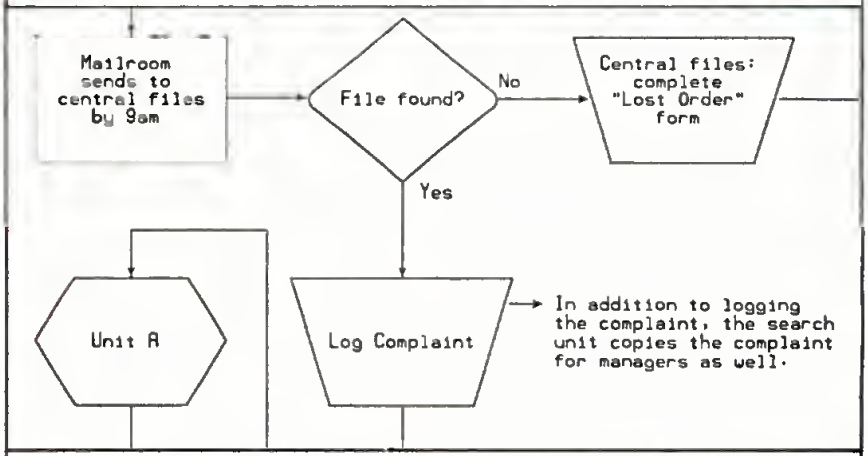
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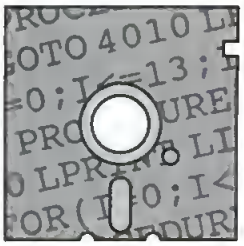
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■ EDITED BY ROBERT L. HUMMEL



LANGUAGES

An easy way to round off numbers; create banners with your printer; a program that redirects output; and a utility that selects any command or program—après Turbo.

BASIC

ROUND AND FLOATING

In my work I find that I often need to round floating-point numbers to a given number of trailing decimal places. Though a variety of methods of rounding numbers have been published, the one shown in Figure 1 is the shortest and most elegant one I've seen yet.

Carl Mankinen
Jacksonville, Florida

This is a clever way to do it, though I was able to trim Mr. Mankinen's code even further by using BASIC's built-in Fix function. This also corrected a small bug in the function when dealing with negative numbers. Many programmers often overlook Fix, which handily combines Int, Abs, and Sgn in one easy-to-use command.
—Ethan Winer

```
Def FnRound#(N#, Places)
    Static Pivot#, Balance#
    Pivot#   = Val("0." + String$(Places, "0") + "5")
    Balance# = Val("1"  + String$(Places, "0"))
    FnRound# = Fix((N#  + Pivot# * Sgn(N#)) * Balance#) _
               / Balance#
End Def
```

Figure 1: *A method for rounding floating-point numbers to a given number of trailing decimal places.*

BANNER OCCASIONS

Special occasions (birthdays, babies, retirements) can be commemorated with banners. Figure 2 shows a short BASIC program that allows you to make banners using your PC printer.

The characters in the banner are formed using the character pattern table, which is stored in ROM at F000:FA6Eh. The lines that use Peek extract a bit from that table and use it to determine whether blanks or blocks will be printed.

The program was written for a Gemini 15x printer, though the printer codes will also work with an Epson FX or RX series printer. The number 239 is the code for the

```
'----- Banner.Bas by James A. Parsly

Width "LPT1:", 255                      'disable line wrap
Def Seg = &HF000                        'segment of ROM chereacters

Line Input "Enter the messege: ", Msg$
Input "Enter Height and Width: ", Height, Wdth

LPrint Chr$(27) "@" Chr$(27) "A" Chr$(4);       'eet 4/72 line specing
Margin = 40 - Height * 4                        'calc vertical center

For Letter = 1 To Len(Msg$)
    Offset = Asc(Mid$(Msg$, Letter, 1)) * 8     'char pettern in ROM
    For Column = 7 To 0 Step -1
        A$ = Spece$(Mergin)
        For Row = 7 To 0 Step -1                'get bits from table
            Bit = Peek(&HFA6E + Offset + Row) And 2^Column
            If Bit = 0 Then
               A$ = A$ + Space$(Height)
            Else
               A$ = A$ + String$(Height, 239)
            End If
        Next Row
        For K = 1 To Wdth
            LPrint A$
        Next K
    Next Column
Next Letter

LPrint Chr$(27) "@";
```

Figure 2: *A BASIC program that lets you create a banner.*

■ LANGUAGES

completely filled-in block in the Gemini 15x character set. This varies quite a bit from printer to printer; for example, an Epson uses ASCII 140, and many other printers use 219.

James A. Parsly
Knoxville, Tennessee

For printers that cannot print the extended ASCII character set, you could instead substitute the actual character being drawn. To do this add the statement

```
Char = Asc(Mid$(Msg$, Letter, 1))
```

immediately below the line

```
For Letter = 1 To Len(Msg$)
```

Then simply replace the 239 with CHAR.
—Ethan Winer

TURBO PASCAL

REDIRECTION

I/O redirection, available in Turbo 3.x, is a powerful technique that lets programs receive input from any source and write output to any destination. The program shown in Figure 3 gives a brief demonstration of this technique. All it does is copy from its input to its output. Compile it to a .COM file and try the following commands:

```
REDIR < input.fil     writes the input
          file to the screen
REDIR > output.fil    puts your keyboard
          input into the output file until
          you type a ^Z (control-Z)
REDIR < input.fil > prn   copies the input
                    file to the printer
```

The $G and $P compiler directives, required for redirection, declare Get and Put buffers for the DOS standard Input and Output. The D- directive disables checking for device I/O and enables redirection.

```
{$G512,P512,D-}
program Re_direction;
(* Compile to REDIR.COM *)
var
  L   : string[255];
  err : text;
begin
  assign(err,'ERR:');
  rewrite(err);
  WriteLn(err,'THIS message goes to the screen even if output is re-directed');
  flush(err);
  while not EOF do
    begin
      ReadLn(L);
      WriteLn(L);
    end;
end.
```

Figure 3: *A Turbo Pascal program that demonstrates redirection.*

```
{$R+}
PROGRAM stuff_command;

TYPE
  wstr = STRING[16];

VAR
  i, k : Integer;
  comm : wstr;

  PROCEDURE Stuff(Str : wstr);
  VAR
    i : Byte;
    head : Integer ABSOLUTE $0040 : $001A;
    tail : Integer ABSOLUTE $0040 : $001C;
    buffer : ARRAY[$1E..$3C] OF Byte ABSOLUTE $0040 : $001E;
  BEGIN
    IF Str[Length(Str)] <> #13 THEN Str := Str+#13;
    tail := head;
```

(continues)

Figure 4: *A program to place a command in the keyboard buffer.*

Even when output is redirected, some messages should go to the screen regardless. Write such messages to the DOS standard error device ERR:. In order to use ERR, you have to assign it to a text file, rewrite it, and FLUSH it each time you write to it.—Neil J. Rubenking

■ STUFFER.PAS utility works by "stuffing" characters into the keyboard buffer.

KEYBOARD STUFFING

The program in Figure 4 shows how to execute any command or program after a Turbo program ends. The procedure must be called last in a program, just before quitting. The command to be executed must be input exactly as it would be if typed from the DOS prompt. Several successive commands can be invoked by pressing the Enter key between them, as long as the total number of keystrokes is less than or equal to 15.

Type in the program STUFFER.PAS and compile it to disk. To run it, enter

```
STUFFER command
```

from the DOS prompt, where *command* is a DOS command or program name.

Enrique Rodriguez
Indianapolis, Indiana

This program works by "stuffing" characters into the keyboard buffer, a task normally handled by INT 9, the hardware keyboard interrupt. It's certainly an easy way to select the program to be executed after your Turbo program. Do note that if you use this technique within a batch file, the stuffed keystrokes will be passed as input to the next program in the batch. Some programs clear the keyboard buffer on input, but many (the Turbo compiler among

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■ LANGUAGES

```
    FOR i := 1 TO Length(Str) DO
      BEGIN
        buffer[tail] := Ord(Str[i]);
        buffer[tail+1] := $0F;
        IF tail = $3C THEN tail := $1E
        ELSE tail := tail+2;
      END;
  END;

BEGIN
  comm := '';
  IF ParamCount > 0 THEN
    comm := comm + ParamStr(1);
  comm := comm + #13;
  stuff(comm);
END.
```

(Figure 4 ends)

```
REM TURBEDIT.BAT -- type "TURBEDIT <filename>"
stuffer ye%1
turbo
```

Figure 5: *A batch file for use with STUFFER.COM.*

them) do not. The batch file TURBEDIT, shown as Figure 5, will bring up Turbo and go directly to editing the filename you give it. That's a useful utility!
—Neil J. Rubenking

Robert L. Huuunel is senior technical editor on the staff of PC Magazine. *Neil J. Rubenking is a contributing editor of* PC Magazine. *Ethan Winer is a contributing editor of* PC Magazine *and owner of Crescent Software in Connecticut.*

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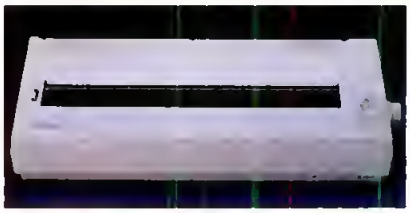
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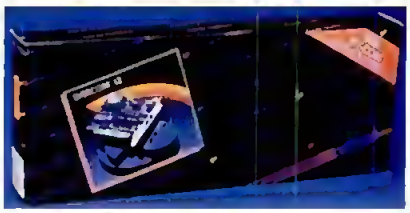
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KEY SWAPPING

I use the numeric keypad when typing in the BASIC program listings in *PC Magazine*. To save time during entry, I use the period instead of the comma to separate the numbers in the data statements. Then I go back and change all the periods to commas with my word processor. Is there any way, however, to redefine the keypad to add a comma key that works inside BASIC?

Derek Howard
Richfield, Utah

The IBM numeric keypad leaves a lot to be desired for data entry. The lack of a comma and Return key make typing long strings difficult. The KEYSUB.COM presented below will, however, allow you to generate the code for any of the keys on the keyboard with any key you select.

When a key is pressed, the keyboard generates a unique scan code *that identifies the key. The BIOS translates the scan code into the more familiar ASCII code. A few keys (the shift keys alone, for example) have no ASCII equivalents or, like SYS REQ, are ignored by the BIOS. KEYSUB cannot be used for such keys.*

You can create KEYSUB.COM either from the assembly language listing in Figure 1 or by running the BASIC program shown in Figure 2. If you choose the assembler route, use Version 2.0 (or later) of the IBM or Microsoft assembler and enter the following commands:

```
MASM KEYSUB;
LINK KEYSUB;
EXE2BIN KEYSUB KEYSUB.COM
```

```
;--------------------------------------------------------------------
;  KEYSUB - Set a second keyboard key equal to the first.  Uses the
;  BIOS to swap ASCII/SCAN or EXTENDED ASCII codes.
;--------------------------------------------------------------------
CSEG      SEGMENT PARA PUBLIC 'CODE'
          ASSUME  CS:CSEG                     ;Not sure of DS when resident

                  ORG     100H                ;SKIP TO END OF THE PSP
ENTPT:            JMP     INITIALIZE          ;COM FILE ENTRY ALWAYS AT 100H

OLD_INT           DD      0                   ;PLACE TO STORE OLD INTERRUPT

KEY1              DW      0
SHIFT1            DB      0
KEY2              DW      0

COPYRIGHT         DB      "KEYSUB (c) 1987 Ziff Communications Co.$",1AH
AUTHOR            DB      "Robert L. Hummel"
MSG1              DB      "Press key to change$"
MSG2              DB      0DH,0AH,"Press new value$"

;--------------------------------------------------------------------

NEW_INT           PROC    FAR

                  STI                         ;Allow interrupts
                  PUSH    BX                  ;Save registers
                  PUSH    AX

                  PUSHF                       ;Simulate an interrupt
                  CALL    DWORD PTR OLD_INT

                  POP     BX                  ;Get old AX in BX
                  PUSHF                       ;Preserve flags
                  OR      BH,BH               ;If wait for key
                  JZ      CHECK               ; see what we got
                  CMP     BH,10H              ;Same for advanced
                  JE      CHECK               ; version of keyboard
EXIT:
                  POPF                        ;Restore flags
                  POP     BX                  ;And BX
                  RET     2                   ;Discard old flags
CHECK:
                  CMP     AX,KEY1             ;If not key to change
                  JNE     EXIT                ; just leave
                  PUSH    DS                  ;Save register
                  XOR     BX,BX               ;Address low memory
                  MOV     DS,BX
                  MOV     BX,BYTE PTR DS:[417h] ;Shift status byte
```

(continues)

Figure 1: *The assembly language listing for KEYSUB.COM, a key substitution utility.*

■ PC TUTOR

```
                        POP     DS                      ;Restore register
                        AND     SS,0FH                  ;Use shift keys only
                        CMP     BX,SHIFT1               ;Is shift state same?
                        JNE     EXIT
                        MOV     AX,KEY2                 ;Swap them
                        JMP     EXIT
NEW_INT                 ENDP

;-------------------------------------------------------------------------
;  Initialization Procedure
;-------------------------------------------------------------------------
                        ASSUME  DS:CSEG                 ;Set by loader.

INITIALISE              PROC    NEAR

                        MOV     DI,OFFSET KEY1          ;Destination for stores
                        CLD                             ;String moves forward
                        MOV     CX,2                    ;Loop twice
                        MOV     DX,OFFSET MSG1          ;First prompt
KEY_LOOP:
                        MOV     AH,9                    ;Write string
                        INT     21H                     ; Thru DOS

                        XOR     AH,AH                   ;Wait for key
                        INT     16h                     ; Thru BIOS
                        STOSW                           ;Save scan/ascii code

                        MOV     AH,2                    ;Get shift status
                        INT     16h                     ; Thru BIOS
                        AND     AL,0Fh                  ;Shift keys only
                        STOSB                           ;Save it

                        MOV     DX,OFFSET MSG2          ;Second prompt
                        LOOP    KEY_LOOP                ;Loop

                        MOV     AX,3516H                ;Get interrupt vector
                        INT     21H                     ;Result in ES:BX

                        MOV     WORD PTR OLD_INT[0],BX ;Save offset
                        MOV     WORD PTR OLD_INT[2],ES ;Save segment

                        MOV     DX,OFFSET NEW_INT       ;Load our interrupt
                        MOV     AH,2516H                ;Set interrupt vector
                        INT     21H

                        MOV     DX,OFFSET INITIALISE ;PART TO SAVE
                        INT     27H                     ;STAY RESIDENT
INITIALISE              ENDP

CSEG    ENDS
        END     ENTPT
```

(Figure 1 ends)

```
100 REM -- BASIC PROGRAM TO CREATE KEYSUB.COM
110 OPEN "KEYSUB.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  28
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 19386 THEN PRINT "Successful Completion:" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,    142,      0,      0,      0,      0,      0,    395
300 DATA      0,      0,      0,      0,     75,     69,     89,    316
310 DATA     85,     66,     32,     48,     89,     41,     32,    444
320 DATA     57,     56,     55,     32,     98,    105,    102,    599
330 DATA     32,     47,    111,    109,    109,    117,    110,    748
340 DATA     98,     97,    116,    105,    111,    110,    115,     32,    ...
350 DATA     67,    111,     46,     36,     26,     82,    111,     98,    577
360 DATA    101,    114,    116,     32,     76,     46,     32,     72,    589
370 DATA    117,    109,    109,    101,    108,     98,    114,    101,    839
380 DATA    115,    115,     32,    107,    101,    121,     32,    114,    739
390 DATA    111,     32,     99,    104,     97,    110,    103,    101,    757
400 DATA     36,     13,     10,     98,    114,    101,    115,    115,    584
410 DATA     32,    110,    101,    119,     32,    110,     97,    109,    717
420 DATA    117,    101,     36,    251,     83,     98,    156,     46,    870
430 DATA    255,     30,      3,      1,     91,    156,     10,    255,    801
440 DATA    116,     10,    120,    255,     16,    116,      5,    157,    883
450 DATA     81,    202,      2,      0,     46,     50,      6,      7,    413
460 DATA      1,    117,    244,     30,     51,    219,    142,    219,   1023
470 DATA    138,     62,     23,      4,     31,    120,    231,     15,    632
480 DATA     46,     58,     62,      9,      1,    117,    224,     44,    563
490 DATA    161,     10,      1,    235,    210,    191,      7,      1,    824
500 DATA    252,    105,      2,      0,    106,     69,      1,    100,    875
510 DATA      9,    205,     33,     50,    228,    205,     22,    171,    923
520 DATA    100,      2,    205,     22,     36,     15,    170,    106,    816
530 DATA     89,      1,    224,    235,    104,     22,     53,    205,   1015
540 DATA     33,    137,     38,      3,      1,    140,      6,      5,    355
550 DATA      1,    106,    107,      1,    104,     22,     37,    205,    743
560 DATA     33,    106,    165,      1,    205,     39,      0,      0,    620
```

Figure 2: *A BASIC program to create KEYSUB.COM.*

Ignore the "no stack segment" warning displayed by the linker: it's normal for .COM files that do not use a STACK segment.

To change the period key on the numeric pad into a comma with KEYSUB is easy. First, make sure that NumLock is on (so the period/Del key types periods at the DOS prompt). Enter KEYSUB and press the period (.) key on the keypad in response to the "Change which key?" prompt. When KEYSUB asks you to "Press new value," you then press the comma key on the regular section of the keyboard. This completes the remapping, which will remain in effect until you reboot your computer. Lotus users might also wish to map the gray Plus key to the Enter key to simplify their data entry.

To prevent surprises, one caution is in order. Left Shift–A, Right Shift–A, and Both Shifts–A generate different codes, and KEYSUB follows them very literally. You can remove key substitutions by rebooting the machine or by using a memory-resident managing utility like INSTALL/REMOVE (PC Lab Notes, Volume 6 Number 14).

WATCHING HIDDEN DISKS

A patch for IBM's VDISK RAMdisk driver in User-to-User, Volume 4 Number 20, placed a rotating symbol in the upper-right-hand corner of the screen whenever the disk was accessed. This patch, however, wrote over the portion of the code that supported extended memory. Is there a more general patch to COMMAND.COM that would accomplish the same thing but work for any disk?

Terry Bavousett
Canyon, Texas

Because each version of DOS is different, providing a generic patch for COMMAND.COM would be difficult indeed. The patch locations would change for each version, and there isn't much room inside COMMAND.COM for patches, anyway.

Fortunately, there's an easier way. DOS provides somewhat of a facility for patching itself by allowing programs to terminate and stay resident (TSR). Taking advantage of this method, I wrote a short

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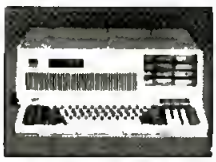
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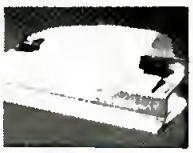
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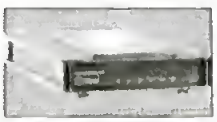
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■ PC TUTOR

memory-resident program that puts a blinking, rectangular-shaped character in the top right-hand corner of the screen when the disk is accessed. Figure 3 lists a DEBUG script you can use to create this program, called DISKLITE.COM.

First, create the file DISKLITE.SCR using a pure-ASCII text editor, such as the WordPerfect Program Editor. *Be sure to hit Return at the end of each line, including the blank lines shown. (As an alternative, you could type the commands directly into DEBUG.) Next, make sure DEBUG is in your current directory or in a directory listed in your PATH statement. Now create*

```
N DISKLITE.COM
A 100
JMP   0139
CALL  0111
PUSHF
CALL  0000:0000
CALL  0111
RETF  0002
PUSH  DS
PUSH  CX
PUSH  BX
PUSHF
MOV   CX,B800
XOR   BX,BX
MOV   DS,BX
CMP   Word Ptr [0463],03D4
JZ    0126
MOV   CH,B0
MOV   BL,[044A]
DEC   BL
SHL   BL,1
INC   BL
MOV   DS,CX
NOT   Byte Ptr [BX]
POPF
POP   BX
POP   CX
POP   DS
RET
MOV   AX,3513
INT   21
MOV   [0107],BX
MOV   [0109],ES
MOV   DX,0102
MOV   AX,2513
INT   21
MOV   DX,0139
INT   27

RCX
53
W
Q
```

Figure 3: *A DEBUG script for creating DISKLITE.COM, which signals when a disk is accessed.*

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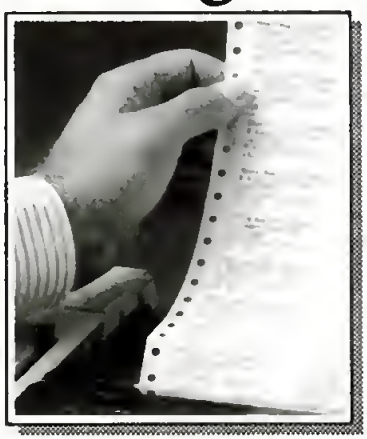
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■ PC TUTOR

DISKLITE.COM by entering the following command:

```
DEBUG < DISKLITE.SCR
```

The best way to load DISKLITE is by including it as a line in your AUTOEXEC .BAT file, before any other memory-resident programs.

For most disk devices used in PCs (the Bernoulli Box being a notable exception), all disk access takes place through INT 13h, the disk service interrupt. DISKLITE works by splicing into this interrupt. Each time a disk function is requested, DISKLITE receives control first. By checking to see if the active monitor is color or monochrome, and how wide the screen is in characters, DISKLITE is able to reverse the attribute of the character in the top right-hand corner. Control is then passed to the original disk interrupt to perform the function. When control is returned, the attribute of the character is restored. During frequent disk access, the block will appear to flicker, much like the access light on a hard disk.

TECH INFO

The question most frequently asked of the PC Tutor is, "Where can I get more information?" Without question, the authoritative source is the IBM PC Technical Books and Publications service. They will be happy to supply a small catalog that lists the available technical publications, which range from the Technical Reference *manual for the original PC to the EGA and VGA adapter specifications. The number is 1(800) IBM-PCTB, and you can call from 9 to 5 Eastern time.*

Robert L. Hummel is senior technical editor on the staff of PC Magazine.

ASK THE PC TUTOR

The PC Tutor solves practical problems and explains points of general interest about using your hardware and software more productively and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016. We're sorry, but we cannot answer questions personally.



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Karl Koessel **PC World**
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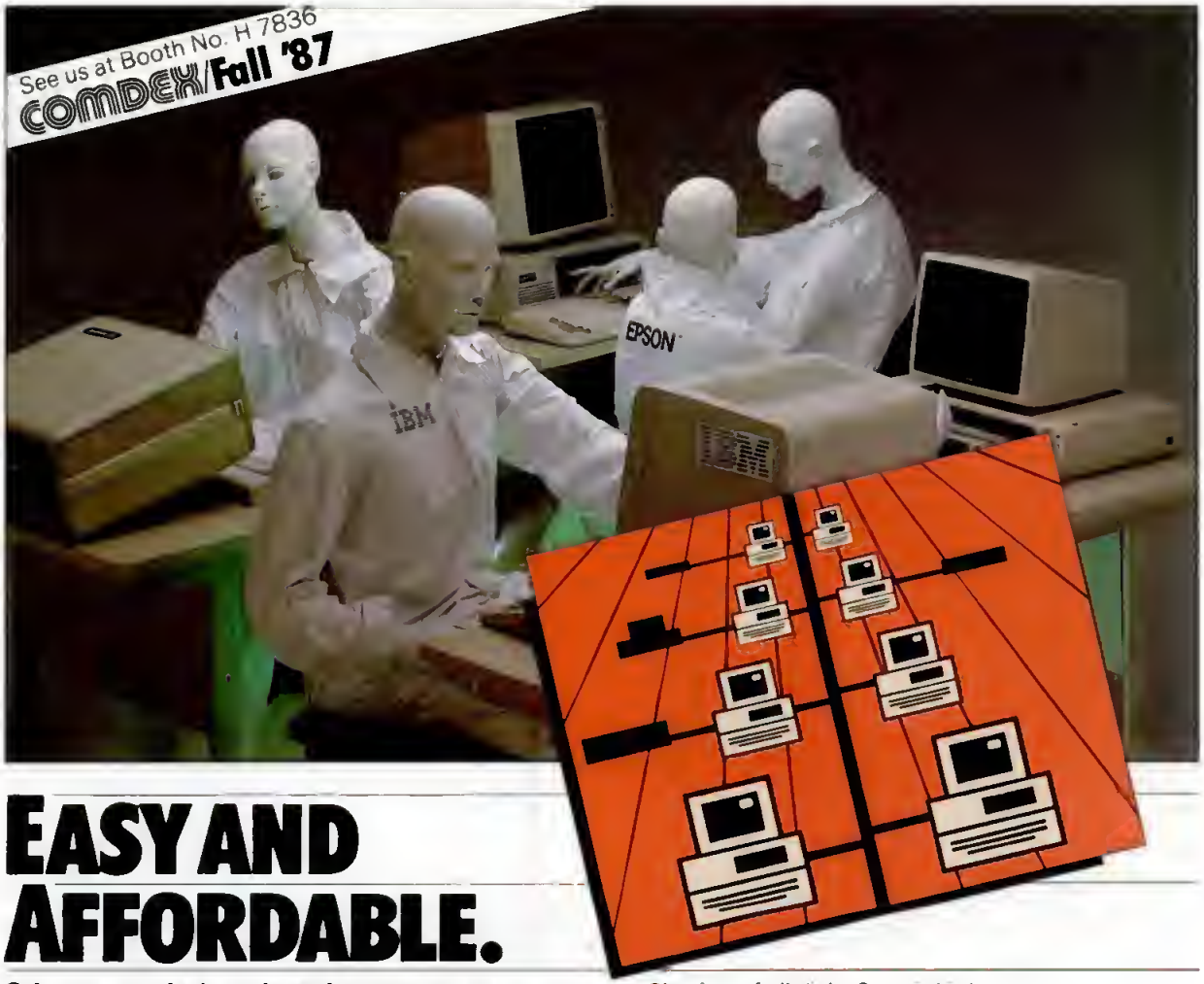
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CONNECTIVITY CLINIC



Communicating in CUT and DFT modes; networking suggestions for a two-station LAN; cost-conscious upgrades for applications software; and the truth about speedy LANs.

MAINFRAME ACRONYMS

I thought I was doing OK in planning our LAN-to-mainframe communications system until I was asked if we ran the CUT or DFT mode. What does this mean?

John Goding
Lockport, Illinois

In IBM 3270 systems, terminals and printers communicate with the 3274 or 3276 cluster controller through a simple communications protocol called Control Unit Terminal mode, or CUT. In CUT mode, one device (terminal, printer, or PC) can connect to one port on the controller or to the display/printer adapter port on a 4321, 4331, or 4361 mainframe. Each physical device can then access one mainframe session. CUT is the typical connection mode and the one you are most likely to have.

IBM developed a form of communications called Distributed Function Terminal (DFT) for certain new coaxially connected devices, including the 3270 PC. DFT mode permits certain devices capable of engaging in multiple sessions to be connected to o single port on the cluster controller.

TWO-STATION LAN?

I am a stockbroker, and I use *dBASE III Plus* for all of my client work. I have written all of my applications and know they would work in a two-station network.

I want my assistant to be able to access the same files I use on a real-time basis. She should be able to update the records, add records, and run reports at any time. We should also be able to share an HP LaserJet printer. We use *Volkswriter 3* and occasionally do large mail-merge jobs that can tie up her computer for an hour. Could this be worked out so as not to affect my own workstation's performance? Which of the many available LANs would you recommend?

Sam Bass
Raleigh, North Carolina

You need networking software that does not use a dedicated server, so the traditional 3Com and Novell solutions are definitely out. You need good speed to use a DBMS, so RS-232C alternatives like LANLink are also out. That still leaves many options; here are several combinations you should consider:

(1) IBM's relatively inexpensive PC Local Area Network Program *running with NETBIOS-compatible network interface cards, such as the StarLAN cards from Western Digital.*

■ I include the PC Local Area Network Program because it is IBM and inexpensive. It is also memory hungry and limited in features.

(2) Western Digital's ViaNet *networking software with Western Digital's StarLAN cards.*

(3) Fox Research's 10-NET.

I include the IBM software in this list only because it is IBM ond inexpensive. It is also memory hungry and limited in features. Both the ViaNet *ond 10-NET solutions provide good value and would work well for you. Contact Western Digital at (714) 863-0102 and Fox Research at (513) 433-1010 for dealer names.*

NEW SOFTWARE NEEDED?

Will we have to buy totally new network-oriented software to run on our new LAN? Is it likely that I can simply buy a networking version of the software I already have so that I won't need to retrain all the users in my office?

Bill Warner
Portland, Oregon

Upgrading software may be one of the hidden costs of installing a network. At a minimum, you will wont to make sure that everybody on the network has the some version of the programs you normally use, so you don't mix up overlay progroms and so you can exchange files without converting. An example is making sure everyone is running the same version of 1-2-3 *so they can exchange files. You also must make sure everyone is running the same version of DOS.*

"Networked" versions of word processing or spreadsheet programs often are not required on a LAN. Your users can, for example, keep their programs on their lo-

■ CONNECTIVITY CLINIC

cal PC drives and only put data files on the server. You can set up subdirectories for individual users on the server so that each person's files are kept separately. Shared data files on the server can be marked as "read only." In practice, the read-only files are copied into private subdirectories and used there. It is common to use non-networked spreadsheet and word processing applications on PC LANs.

■ Upgrading software may be one of the hidden costs of installing a network.

However, if you are going to have multiple simultaneous access to the same files through a DBMS, then you need a networked DBMS system. Some database programs, such as dBASE III, rely on DOS to regulate file sharing, while others, like Ansa Software's Paradox, *use their own file-sharing schemes.*

So when you install a LAN, be prepared to upgrade all software in every network station to the same version and be prepared to invest in a networked DBMS. But networked versions of other applications programs are not required.

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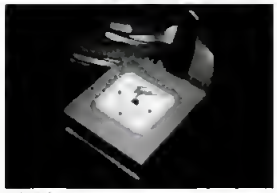
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PC Magazine and other publications focus on the issue of speed in a network. Why is file transfer speed so important? Isn't it true that the transfer speed the user sees is more influenced by the speed of the workstation CPU and DOS? What differences would I observe sitting at my PC if I could use different networks having different speed ratings?

Don Winslow
Aiea, Hawaii

Gulp, good questions, Don. First, I assume you know that the rated speed of a LAN (e.g., 10-megabit-per-second Ethernet and 1-megabit-per-second StarLAN) is practically meaningless . That is why we test actual performance. With some tasks, such as loading a spreadsheet or word processing document, you'll see little difference subjectively between "fast" and "slow" networks. Even DEC admits that only a small fraction of Ethernet's 10-megabit-per-second data transfer speed is used, even in large installations. Yes, the speed of the workstation CPU has a significant impact on the speed of interaction with the LAN.

However, when you do some DBMS chores, like performing random searches or reindexing files, you drag a lot of data between the file server and the workstation. These tasks test all parts of the LAN. You are correct in your implication that speed isn't everything in PC-based LANs, but it is important for some tasks.

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.

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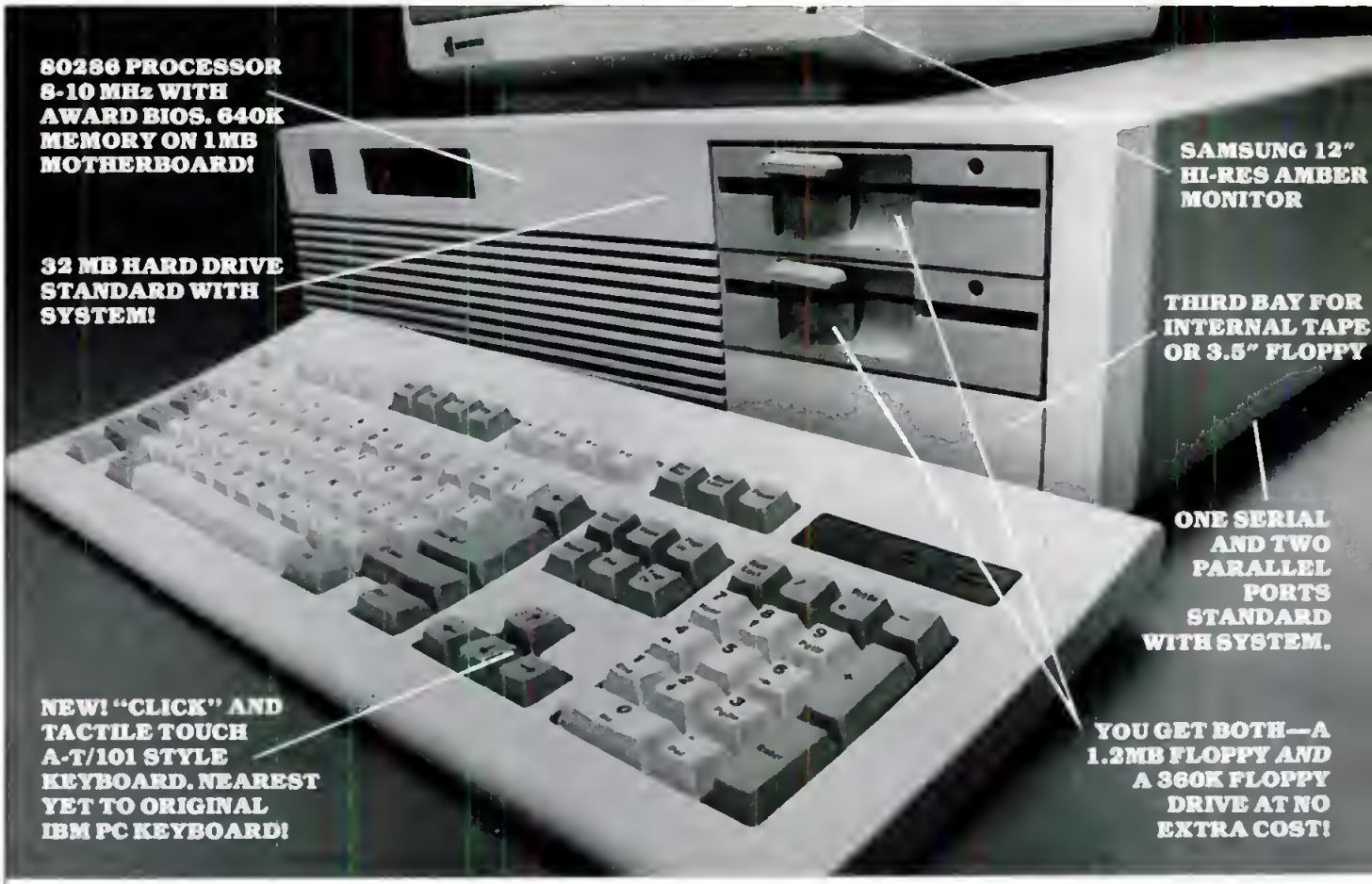
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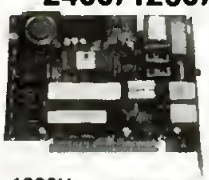
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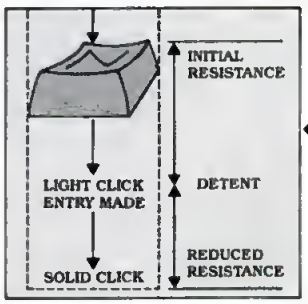
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The real thing. Intel 80386-16 CPU with 80387 Coprocessor. Intel 512K motherboard with two 8-bit slots, four-16 bit, and two 32 bit slots. Phoenix BIOS. 220 watt power supply. Serial & Parallel ports. 88 key "AT" or 101 key "RT" keyboard. 1.2 Mb floppy drive. Western Digital Floppy/Hard Disk Controller. 1 Year Warranty.

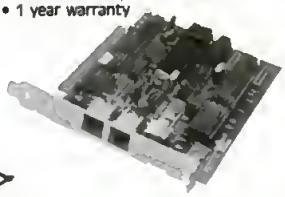
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- Line-busy detect and auto redial
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- Menu Driven software with On-line help
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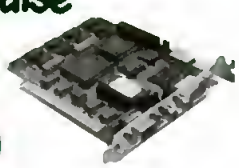




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- Plugs into floppy controller in PC or AT
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- Up to 42 MB per cartridge
- 3COM & Novell Network Compatible

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- EGA, CGA, MDA, & Hercules Compatible
- Short Card, 5.25" long
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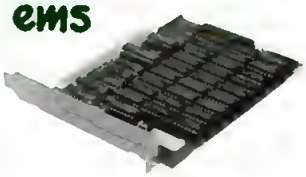
AT hard disk kits

- Includes AT mounting rails, & data cable
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FH	MiniScribe 6053	28ms	44.6MB	$619
FH	MiniScribe 6085	28ms	44.6MB	$888
FH	Micropolis 1335	28ms	71.3MB	$899
FH	Priam 519	20ms	71MB	$2295
FH	Maxtor 1140	27ms	117MB	$2295
FH	Priam 519/Award	20ms	159MB	$2395

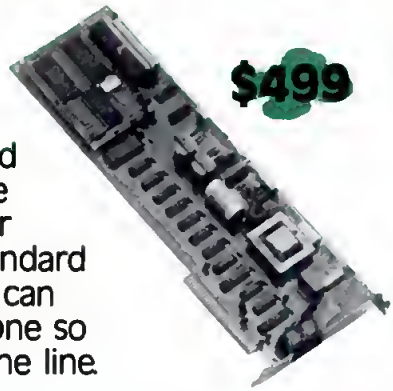
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$179



- 768K of 120ns RAM
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- Can backfill to 640K, remainder as EMS
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- 1 MB piggyback board option $169
- Pop-up window print spooler, and RAM disk software

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a full-length, XT height, expansion card that occupies a single slot. It plugs into your phone line with a standard RJ11 phone jack. You can also plug in a telephone so you won't lose a phone line.

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- 9600 bits per second transfer speed
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- Background receiving of documents up to 99 pages long
- Integrate fax image with text documents
- Phone directory of commonly dialed destinations
- Use as a 9600 baud modem to send files to other FAX/96 modems
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Requirements: PC compatible with 512K RAM, DOS 3.0 or later, hard disk drive, & graphics adapter.

FAX/96 includes: Full-length circuit board, PC/ MS-DOS compatible software, phone cord, 1 year warranty, 30 day money back guarantee.

Shamrock V20

$549



- NEC V20, 4.77 or 8 Mhz Speed
- Phoenix BIOS, Norton SI 31
- 640K RAM, 8 Expansion Slots
- 360K Floppy, Serial, Parallel, & Game Ports
- Battery back clock/calendar
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with Mono/Graphics card & Tilt/Swivel Mono Monitor	$699
with Color Graphics card & Samsung Color Monitor	$929
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Western Digital 30MB filecard

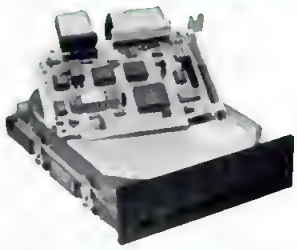


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- 62 msec Average Access Time
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- High Speed WD RLL controller
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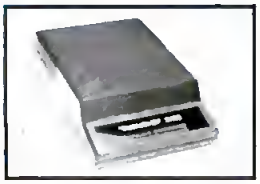
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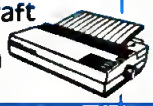
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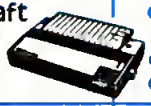
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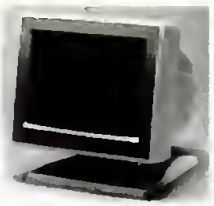
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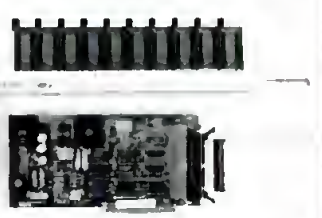


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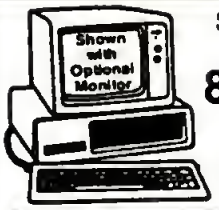


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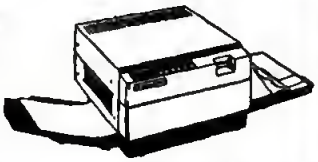
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6. Does your company own
- r. ☐ Mainframe(s)
- s. ☐ Mini(s)

7. Do you plan to to buy
- t. ☐ Now
- u. ☐ In 4 to 6 months
- v. ☐ In 6 to 12 months
- w. ☐ No definite plans

8. Number of employees in your company:
- x. ☐ 25 or less
- y. ☐ 26-99
- z. ☐ 100-499
- 1. ☐ 500-999
- 2. ☐ 1000 or more

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c. ☐ Education

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f. ☐ Finance/Accounting
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j. ☐ No

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n. ☐ 100 or more

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o. ☐ Linked to mainframe
p. ☐ Linked to mini
q. ☐ Networked together

6. Does your company own
r. ☐ Mainframe(s)
s. ☐ Mini(s)

7. Do you plan to to buy
t. ☐ Now
u. ☐ In 4 to 6 months
v. ☐ In 6 to 12 months
w. ☐ No definite plans

8. Number of employees in your company:
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Software Expert Reveals The Truth About How He "Remembers" 1,017 Program Commands

It's overwhelming. By actual count there are 1,017 commands to remember.

That's because I use several different software packages in my business. (You probably do too.) In all there are 1,017 commands I may have to recall to get my work done efficiently.

Wouldn't it be fantastic to instantly recall any command you or I needed? With ease? Without digging through manuals?

Good Memory But...

Now I have a good memory. But not for things like "Alt-F8." I just can't seem to remember that it means "Page Format" in WordPerfect. And I'm no beginner.

Since 1968 I've been working with computers and software, and I still get frustrated by the complexity of these bit-brained boxes. And their so-called "user friendly" software. The programs I use are about as "friendly" as a rattlesnake.

So I invented something to make my life (and yours) easier.

Needed a Simple Solution

I needed a simple solution to the problem of remembering cryptic software commands, so I designed **PC-DocuRef**, a combination keyboard "template" and reference booklet. This handy unit attaches to any keyboard. On it, the commands for a given program are concisely defined and meticulously organized.

You see, since 1982 my company has made keyboard templates for most popular software and keyboards. These quick-reference guides, called PC-DocuMates, are "bestsellers" with over 600,000 in use, and have become a "classic."

But today, software is much more elaborate and there are about 100 different keyboard styles. I saw the need for a universal reference aid that would fit any computer, even laptops and portables. And provide more information for complex software than is possible on a template. Our classic templates fit 5 different keyboard styles, and they are still a great solution. But as you can see from the picture here, **PC-DocuRef** is designed for any keyboard.

Special panels slide out from the booklet base, giving you the convenience of a template. Then the booklet gives you comprehensive reference at a flip of the tabbed pages. And it's made from a unique plastic material which won't fade, tear, or get dog-eared with use.

Convenient and Easy to Use

Because it attaches snugly to the top of the keyboard and puts needed information at your fingertips, **PC-DocuRef** is easy to use and truly convenient. No searching for reference cards or booklets which get lost or torn up. No digging through manuals, either.

PC-DocuRef just sits handily on your keyboard, held in place by velcro tabs on the back. To remove it you just lift it off. So when you shift from your favorite word processor to your spreadsheet, you can just slip the next **PC-DocuRef** on. And it's simple to use because of the unique design.

Functionally Organized for Finding Commands Fast

The commands are organized by the function you want to perform, like DELETE or FIND or SAVE. You can find the command you want about 20 to 30 times faster than looking in the manual.

Each function is defined by a color-coded heading or tab, which makes finding the command you need quick and easy. We use color-coding consistent with the software manufacturer's documentation. This makes key combinations easy to understand and remember. Function key commands are specified on a separate color-coded template (for IBM "Enhanced" style keyboards) and also on the left slide-out template.

Obvious Benefits

The outstanding benefit of **PC-DocuRef** is that it helps you get your work done faster and easier.

Personally, I get a 15% to 20% improvement in my productivity on familiar software and even greater improvement on less often used packages. That means I can save up to an hour a day, just by using my **PC-DocuRefs**.



Software expert Jack Segner, designer of memory-saving PC-DocuRef™ and PC-DocuMate™



PC-DocuRef™ provides a simple solution to the problem of mastering complex software

Surprising Benefits

But there are some surprising other benefits.

The concise summary of the commands seems to simplify the entire software package. I find it increases my confidence in using a complex program.

It's easy to try new features and extend your skill and competence when everything you need is neatly summarized right on your keyboard.

And when you don't use a package every day **PC-DocuRef** is like a quick "refresher" course each time you sit down at the keyboard. But there's a bonus benefit.

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But Still Not Perfect

As efficient and helpful as **PC-DocuRef** is, it's still not perfect. The commands are fully summarized, but sometimes you will need more detail from a software manual. However, for most commands you use, **PC-DocuRef** is all you ever need for reference.

Who Needs a PC-DocuRef?

I really need **PC-DocuRef** to help me remember. It's easy to forget what "F3" and "Alt-B" and "Shift-F7" mean in six different programs, when you have more important things on your mind. Business and professional people are busy using the computer to get work done. We don't need to clutter our brains with arbitrary commands like "Ctrl-F2." So if you want to get the most from your computer, without memorizing thousands of commands, you need **PC-DocuRefs**.

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HOW TO SUCCESSFULLY BUY THROUGH MAIL ORDER AND PROTECT YOUR RIGHTS

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FTC rules say:

1. The Seller must ship your order within 30 days of receiving it, unless the advertisement clearly states it'll take longer.

2. If it appears that your order will not be shipped when promised, the Seller must notify you in writing in advance of the promised date, giving a definite new date, if known, and offering you the opportunity to cancel the order with a refund or consent to a definite delayed shipping date or an indefinite delay.

3. The Seller's notice must contain a stamped self-addressed card or envelope with which you can indicate your preference. If you don't respond to this notice, the Seller may assume you agree to the delay, but must either ship or cancel your order within 30 days after the original shipping date promised or required. A prompt refund must be made when an order is cancelled.

4. Even if you've consented to an indefinite delay, you retain the right to cancel the order at any time before the item has been shipped.

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6. In the event that the item you ordered is unavailable, the Seller may not send you substitute merchandise without your express consent.

TIPS WHEN ORDERING

When ordering by mail:

State precisely what merchandise you want, specifying details such as model, make, size, component parts, etc.;

Confirm the price and expected delivery date as stated in the ad;

Indicate whether you will accept a substitute product if the item you ordered is unavailable, and, if not, that your payment should be returned;

Don't send cash, you will have no record of payment if a problem arises, and;

Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your cancelled check or a copy of the money order; record of the date you mailed the order; and any sales slips and shipping receipts.

When ordering by phone:

Note the time and date of your conversation and the name of the person you talk with;

Make a record of your order, the price, its promised availability and the components to be expected;

Save all correspondence associated with your order, including your cancelled check or a copy of the money order, and any written confirmation sent by the Seller.

Questions you should consider asking:

Does the advertised item come with all necessary parts and accessories? Are they from the same manufacturer?

Is it available for immediate shipping?. If not, when will it be available?

Has there been an increase in the advertised price?

What warranties does the item carry? Who provides the service?

What is the Seller's return policy?

What is the Seller's refund policy?

With whom should you correspond if there is a problem?

IF YOU HAVE PROBLEMS:

1. If you have not received your order as promised or if the item is defective, immediately notify the Seller in writing referring to your order by description, price, date, as well as by account number and order number, if available. Make sure you keep a copy of the letter.

2. If you complain by telephone, send a follow-up letter to confirm what was said.

3. If you think the merchandise is defective, reread your product instructions and your warranty carefully to be sure you don't expect features or performance the product isn't designed to give. Then contact the Seller for instructions. Don't return it to the Seller until you have been instructed to do so.

4. When returning merchandise make sure you keep the shipper's receipt or packing slip; your right to be reimbursed for postal cost is determined by store policy.

5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

PC MAGAZINE

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MARKETPLACE

HARDWARE

ADD-ON-BOARDS 575
CABLES
COMMUNICATIONS . 575, 576
COMPUTER SYSTEMS 576, 577
DISK DRIVES 577, 578
DISKETTES 578, 579
EXPANSION UNITS 579, 580
MONITORS
PERIPHERALS 580
PLOTTERS 581
POWER PROTECTION
POWER SUPPLIES 581
PRINTERS 581
SECURITY 581
SPEED DEVICES . . 581, 582

SOFTWARE

ACCOUNTING 582
ARTIFICIAL INTELLIGENCE . . . 582, 583
BACKUP SYSTEMS 583
BUSINESS 583, 584

SOFTWARE *continued*

BUSINESS PROJECT MANAGEMENT 584
BUSINESS TIME MANAGEMENT 584
COMMUNICATIONS . . . 584
CONSTRUCTION 584
DATA BASE 584, 585
DATA ENTRY 585
DATA MANAGEMENT
DESKTOP PUBLISHING 585
DEVELOPMENT TOOLS 585, 586
EDUCATION 586
ENGINEERING 586
ENTERTAINMENT/ GAMES 586, 587, 588
FINANCIAL 588
GENERAL 588
GRAPHICS 589
HEALTH 589
INVENTORY 589, 590
LANGUAGES 590
LEGAL 590
MAILING PROGRAMS 590
MANUFACTURING 590

SOFTWARE *continued*

MEDICAL 590
MULTI-USER SYSTEMS
MUSIC 590, 591
ONE-OF-A-KIND 591
OPERATION SYSTEMS
PREVENTATIVE MAINTENANCE 591
PUBLIC DOMAIN 591
REAL ESTATE 591, 592
RELIGION 592
SALES MARKETING 592
SCIENTIFIC
SECURITY 593
SERVICES
SHAREWARE 593
STATISTICS 593, 594
TAXES 594
TERMINAL EMULATION 594
TRAINING 594
TRAVEL
UTILITIES . . . 594, 595, 596, 597
WORD PROCESSING 597

MISCELLANEOUS

ACCESSORIES 598
BAR CODING 598
BOOKS 599
BUSINESS OPPORTUNITIES 599
CATALOGUES 599
COMPUTER INSURANCE 599
COMPUTER LEASING
COMPUTER SERVICES . 599
COMPUTER TRAINING
CONSULTANTS
CONVERSION SERVICE . . .
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DIGITIZERS
DISK CONVERSION . 599, 600
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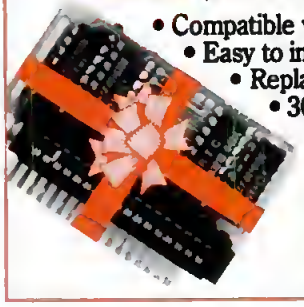
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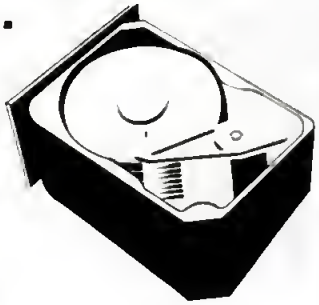
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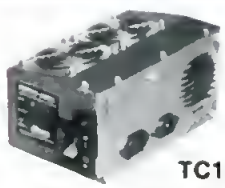
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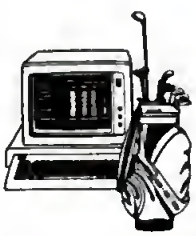
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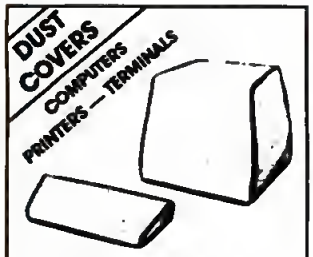
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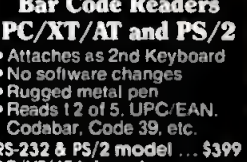
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PC MAGAZINE ADVERTISERS PRODUCT INDEX

RS#	ADVERTISER	PRODUCT	PAGE#
ACCOUNTING SOFTWARE			
482	Bedford Software Limited	Accounting Software	91
149	DAC Software	DAC - Easy Accounting 2 0	40-41
263	Macola Inc	Accounting Software	51
384	Magent Software	In House Accountant	289
358	Peachtree Software	Peachtree Complete II	345
104	Q W Page	Accounting Software	441
148	Viewpoint Software	Viewpoint Check Mate	467
DESK TOP ORGANIZERS			
307	FUTURESOFT	Right Hand Man	39
DATABASE MANAGERS			
337	Borland International	Paradox	55
494	Bullpinware	PC File +	510
248	Canterbury International	Database	289
217	Conductor Software	ACT!	359
721	Cosmos Inc	Revelation - Database Manager	323
375	Data Access Corporation	Data Flex	233
723	Dialog Information Services	Dialog Business Connection	79
246	Fox & Geller	Quick Code	531
339	Inset Systems Inc	Inset 2 0	429
529	The Public Software Library	S/W by Public S/W Library	21
DECISION SUPPORT SYSTEMS			
478	Day-Flo Inc	Database Software	486
FILE SYSTEMS & ACCESS METHODS			
210	Ashton Tate	File System Software	387
137	Borland International	Turbo C	57
302	Micro Com Systems	Multifunction 8 Pub Domain S/W	18
526	Microlytics	Go-Fer	371
248	Symantec	Q & A Write	451
529	The Public Software Library	S/W By Public S/W Library	21
FINANCIAL PLANNING SOFTWARE			
*	Javelin	Javelin Plus	277-282
INFORMATION MANAGERS			
330	Dynamic Microprocessor Assoc	Chairman	451
302	Micro Com Systems	Multifunction 8 Pub Domain S/W	18
INTEGRATED SOFTWARE			
137	Borland International	Turbo C	57
*	Innovative Software	Networking Software	298-301
339	Inset Systems, Inc	Inset 2 0	429
490	Kreger Data	Integrated Software	532
354	Software Group, The	Enable	430-431
LANGUAGES			
152	Barrington Systems	Clarion	70
137	Borland International	Turbo C	57
138	Borland International	Turbo Pascal 4 0	C2-1
360	Crescent Software	Quick Pac	522
*	Ellis Computing	Utah DOS Language	532
*	Microsoft	Promotion	C5-8
OPERATING SYSTEMS/ENVIRONMENTS			
485	Quantum Software Systems, Inc	QNX	355
393	Software Link Inc	PC MOS	29-31
PROGRAM DEVELOPERS/GENERATORS			
360	Crescent Software	Quick Pac	552
PROJECT MANAGEMENT			
173	Inmax	Project Vision	363
502	Instaplan	Proj Planning&Presentation Sys	385
187	Primavera Systems	Project Management Software	88
STATISTICAL SOFTWARE			
*	Lotus Development Corp	Grapherwriter	263 265
154	Math Soft Inc	Math CAD	42
TEXT EDITORS			
186	Command Technology Corp	Text Editors	442
TRAINING SOFTWARE/PUBLISHING			
170	Simon & Schuster	Typing Tutor IV	437
UTILITIES			
120	Central Point Software	PC Tools	106
156	Central Point Software	Copy II PC Option Board	436
297	Front Runner Co	Top DOS	414
311, 315, 318	Funk Software	Inword Noteworthy Sideways	293-295
389	Golden Bow Systems	V Opt	513
302	Micro Com Systems	Multifunction 8 Pub Domain S/W	18
193	Paul Mace Software	Paul Mace Utilities	243
489	Personal Computer Support	Breakthru 286 286+, Lightning	88
282	Personics Corp	See More	19
290	Rose Electronics	Passport	488
334	Softlogic Solutions	Magic Mirror	203
168	Software Directions	Print Q	235
*	Transecsystems, Inc	Unlock	68
*	Westlake Data Corp	PC Fullback	381
309	White Crane Systems	Brooklyn Bridge	443
WORD PROCESSING SOFTWARE/AIDS			
217	Conductor Software	ACT!	359
325	HDG Software Inc	Legal Ease	559
*	Lotus Development Corp	Manuscript	163 165
540	MCS Group	Document Conversion	451
302	Micro Com Systems	Multifunction 8 Pub Domain S/W	18
332	Micropro International	Wordstar	373-377
*	Microsoft	Word 4.0	C5-8
479	Rightsoft Inc	Right Writer	402
170	Simon & Schuster	Typing Tutor IV	437
*	Software Publishing	PFS Write Word Processing S/W	143
249	Symantec	Q & A Write	451
251	Symantec	Q & A Write	415
518	XYQuest	XYWrite III Plus	308
318	Zylab Corporation	Word Processor Text Retrieval	436
CAD/CAM			
475	American Small Business Comp	Pro Design II	482
164	Autodesk	Autosketch	478
506	Generic Software Inc	Generic Cadd	26
SPREADSHEET/TEMPLATES			
311, 315, 318	Funk Software	Inword Noteworthy Sideways	293-295
*	Javelin	Javelin Plus	277-282
363	Mosaic Software	Spreadsheet Software	496
483	Personal Computer Support	Lucid	89-91
282	Personics Corp	See More	19
288	Softlogic Solutions	@ Liberty	412-413
323	Surpass Software	Spreadsheet Software	204
156	Systems Management Assoc	PC Docu-Ref	569
529	The Public Software Library	S/W by the Public S/W Library	21
DESK TOP PUBLISHING			
115	Application Techniques	Pizazz	240
349	Canon USA Inc	Desktop Publishing	408 409
321	Destiny Technology	Laser Act I	411
118	SWFTE International, LTD	Glyphix	403
233	Unison World	Newsmaster	493
DATA ENTRY SOFTWARE			
174	Form Worx Inc	Form Worx	78
VERTICAL MARKET SOFTWARE			
143	Cadam Incorporated	Engineering Software	327
EDUCATIONAL SOFTWARE			
750	Ad Lib	Music Software	609
ENTERTAINMENT SOFTWARE			
750	Ad Lib	Music Software	609
282	Microprose, Inc	Gun Ship for IBM	607
FORM DESIGNERS			
126	EZX Corp /Ford Software	EZ-Forms Executive	4
COMPATIBLE COMPUTERS			
247	Northgate Computer Systems	Keyboard	549
DISK BACKUP & TAPE DRIVES			
273	3M Data Recording Products Div	Tape Backup	455, 457
255	Alloy Computer Products	Disk Back Up	147
153	Archive Inc	Tape Backup	389
232	Cipher Data Products Inc.	Tape Backup	523
225	Core International	Core Drives	183
180	Flagstaff Engineering	Tape Backup	572
306	Identica	Professional Tape System	418
378	Iomega Corporation	Bernoulli Box	116-117
107	Mountain Computer Inc	Tape Backup	106
*	Sysgen Inc	Tape Backup System	325
HARD DISKS			
225	Core International	Core Drives	183
306	Identica	Tape Backup	418
106	JDR Micro Devices	Mail Order	558-559
*	Lifetime Memory Products	Hard Disk Drives	236
220	Nestar Systems	Co-Star	201
536	Priam	Hard Drive	328
236	Qube	EGA Board	331
478	Storage Dimensions/Maxtor	Disk Drive	242
COMPUTERS/COMPATIBLES			
507	American Micro Technology	PC	2-3
303	Amstrad Inc	The Amstrad Line	111
117	Ancom America	PC	490
*	Bentley Computers	Compatible	82-83
481	Bull Dog	Computers & Accessories	460-461
337	CCDA	AT Clone	491
505	Club AT	Desktop Computers	534-535
*	Compaq Computer Corporation	Deskpro 386	169-176
258	Data Media	Diskless Work Station	541
386	Five Star Electronics Inc	PC Compatibles	340-341
253	Great Western Electronics	Tandy Computers	570
744	Hewlett Packard	Printer Paint Jet	480-481
740	IBM Corp	PS/2 Model 25	189
389	Indtech	S1§1 Series	496
*	Intelligent Microsystems	Compatibles Systems	506-507
*	Motorola Computer Systems	Motorola Computer Systems	129-136
234	Northgate Computer Systems	AT Clone	545
240	Northgate Computer Systems	XT Clone	547
370	PC Designs	Compatibles	313
*	PC's Limited	Desktop Computers	224-225
353	Protege	The Protege AT	37
122	QIC Research	QIC 286 System	274
316	Samsung Electronic Devices	PC	360
384	Speld Computer Systems	Compatibles	49
135	Tandon Corp	Tandon PC	529
289	Tandy/Radio Shack	1000TX	417
*	Toshiba	Computer T3100	377
*	Toshiba	T1000 Computer	141
340	Vector Computer Corporation	AT Clone	103
515	Wells American	A Star	5
529	Whole Earth Computer	Desktop Computers	502
INPUT DEVICES			
140/141	Data Desk International	Keyboards	321
244	Key Tronic	Keyboard	109
*	Microsoft	New Mouse	C5-8
350	Mouse Systems	The Mouse	144
131	Torrington Company, The	Cordless Mouse	287
PROGRAMMERS TOOLS UTILITIES			
137	Borland International	Turbo C	57
120	Central Point Software	PC Tools	106
156	Central Point Software	Copy II PC Option Board	436
360	Crescent Software	Quick PAC	523
297	Front Runner Co	Top DOS	414
317	Oakland Group Inc	C Scape	521
335	Programer's Paradise	Mail Order	552
111	Software Masters	Programming Tools	512
MULTIFUNCTION BOARDS			
106	JDR Micro Devices	Mail Order	558-559
106	Zuckerboard ATD	PS/2 Family	444
ADD-ON BOARDS			
*	AST Research	Boards	253
181	Quadram Corp	PS/2 Family	191
106	Zuckerboard-ATD	PS/2 Family	444
SCANNERS/DIGITIZERS			
147	Data Copy	730 Scanner	477
735	Micro-TEK	Scanner	426

RS#	ADVERTISER	PRODUCT	PAGE#
392	SABA Tech	Hand Scanner	498
178	The Laser Connection	IS 300	521
PRINTERS			
219	Acer Technologies	Laser Printer	318-319
725	Adobe	Postscript	100-101
242	Alps America	Printers	206-207
•	Ast Research	Printers	166
727	C Itoh Digital Products	Printer	254
351	Canon USA Inc	Printers	442-443
348	CIE Terminals	Laser Printer	199
124	CIE Terminals	Quick Zipper C14000	305
114	Citizen America Printer	Printer	9
112	Citizen America Printer	Printer	251
321	Destiny Technology	Laser ACT I	411
•	Diconix	Printer	121
•	Epson	Printer	105
724	Fujitsu America Inc	Printers	315
283	Genicom	Printer	231
509	Hewlett Packard	Laser Printer	159
519	IBM Corp	Printers	366-367
382	Mannesmann Tally	Highend Dot Matrix Printer	271
•	NEC Information Systems	Printer	273
722	OASYS	Laser Printer	157
197	Okidata	Microline 393	348
194	Olympia USA	Printers	511
176	Personal Computer Products Inc	Laser	187
293	Printers Plus	Printers	429
218	Printers Plus	Printers	566
729	Ricoh of America	Printer	458
356	Star Micronics	Printer	500
176	The Laser Connection	PS Jet	521
•	Toshiba	Laser Printer	180-161
•	Toshiba	Toshiba	12-13
503	Western Telematic	Laser Printer	217
PRINTER RIBBONS			
306	National Computer Ribbons	Printer Ribbons	548
PRINTER ACCESSORIES			
327	Applied Creative Technology	I Systemizer, Systematic	47
•	Bay Technical Associates	Print Master	565
328	Buffalo Products	The Buffalo SX	196
213	CSI	Duet	127
295	Dresselhaus Computer Prod	Dots Perfect	540
296	Fifth Generation	Printer Sharing Device	125
285	Giltronix	Printer Sharing Device	314
155	Intellecom	Printer Extender Cable	400-401
272	Kensington Microware	Printer Mufflers	290
•	Quaid Software LTD	Software	372
290	Rose Electronics	Masterswitch	488
726	Softcraft Inc	Laser Printer Font	392
178	The Laser Connection	PS Jet	521
119	TIPZ	Printer Switch	540
222	Worthington Data Solutions	Printer Accessories	347
PORTABLE/LAP COMPUTERS			
190	Datavus	The Datavue Family	470
223	Traveling Software	Laplink	438
372	Zenith Data Systems	Computer Systems	333-335
PC-FAX			
147	Data Copy	Microfax	477
DISPLAYS & MONITORS			
102	Amdek	Monitor	449
166	Eastman Kodak	Datashow PC Overhead Protector	228
209	Princeton Graphics	Ultrasync Monitor	390-391
236	Qubie	EGA Board	331
504	Taxan	Desktop Publishing	193 195
GRAPHICS SOFTWARE			
475	American Small Business	Prodesign II	482
115	Application Techniques	Pizazz	240
367	Banner Blue	Org Plus	465
360	Crescent Software	Quick PAC	522
174	Form Worx Inc	Form Worx	78
201	Haventree Software	Flow Charts Software	516
157	Hewlett-Packard PS	Gallery Graphics	285
339	Inset Systems Inc	Inset 2 0	429
•	Lotus Development Corp	Graphwriter	263, 266
•	Lotus Development Corp	Freelance	504-405
746	Media Cybernetics	Dr Halo 3 0	211
366	Microrim	DB Graphics	62-63
VIDEO GRAPHICS/BOARDS			
115	Application Techniques	Pizazz	240
142	Hercules Computer Technology	Graphics Board	343
159	Paradise Systems	Paradise EGA	212
191	Quadram Corp	PS/2 Family	191
236	Qubie	EGA Board	331
252	Sigma Designs	Sigma VGA Board	215
517	STB Systems	VGA Extra	364
127	Video-7	VGA Board	74-75
ACCELERATOR BOARDS			
276	Hauppauge	386 Motherboard	32
•	Microway	Accelerator Boards	382
492	Orchid Technology	Orchid's Turbo Family	50
489	Personal Computer Support	Breakthru 286 286+, Lightning	66
236	Qubie	EGA Board	331
COMMUNICATIONS SOFTWARE			
278	Crosstalk Communications	Crosstalk Mark 4	369
326	Crosstalk Communications	Crosstalk XVI	76
290	Rose Electronics	Passport	488
523	Softklone	Mirror II	416
235	Softronics	Softerm PC	407
223	Traveling Software	Laplink	438
LOCAL AREA NETWORKING			
326	Crosstalk Communications	Crosstalk XVI	78
280	Digital Products	Lan	536
199	Easy Net Systems Inc	Lan	536
324	Gateway Communications	Lan	533
361	Information Builders	PC Focus	80
•	Innovative Software	Networking Software	298-301
103	Novell Inc	Netware	423-425
290	Rose Electronics	Masterswitch	488
128	Server Technology	Easy Lan	492
313	Simplenet	Networking	487
314	Simplenet	Networking	485
129	Standard Microsystems Corp	Arcnet	113
MICRO-MAINFRAME LINKS			
531	DCA	IRMA II	244-245
495	Maynard Electronics	Maynard Tape Drives	219

RS#	ADVERTISER	PRODUCT	PAGE#
MODEMS			
136	Hayes Microcomputer Products	Hayes Modems	396-397
108	JDR Micro Devices	Mail Order	558-559
302	Microcom Systems	High Speed Modem	18
730	Natural Microsystems	Watson	499
236	Qubie	EGA Board	331
487	Racal-Vadic	Modem	319
231	Touchbase Systems	Portable Modem	539
364	Ven-Tel	Modems	18
EMULATORS/PROTOCOL CONVERTERS			
365	Persoft	Terminal Emulation	64
DISKETTES			
195	Precision Data Products	Diskettes	572
271	Sony Corporation of America	Diskettes	72
134	TDK Electronics	Diskettes	119
•	Trace Incorporated	Ghostwriter High Performance	512
POWER PROTECTION			
391	Cuesta Systems Corp	Datasaver	488
381	Para Systems	Minuteman	347
473	PC Cooling Systems	Power Supplies & Cooling Fans	138
191	Perma Power Electronics	Surge Surpressor	410
739	Safe Power Systems	Power Supply	418
PC ACCESSORIES			
185	Accessafile Canada Corp	Accessafile	571
221	Charles W Wolf, Inc	Laptop Carrying Case	447
518	Computer Accessories	Power Director	227
•	Curtis Manufacturing	PC Accessories	432, 434
187	Damark International	Watch	565
287	Hub Disk Computer Products	Printer Accessories	266
265	International Battery Corp	Replacement Battery	388
390	Microsync Computer Products	dClock II	29
473	PC Cooling Systems	Power Supplies & Cooling Fans	138
•	Trace Incorporated	Ghostwriter High Performance	512
MAIL ORDER			
169	786 Computers	Mail Order	60-61
533	Access Micro Center	Mail Order	526
357	Advancedware	Mail Order	519
178	American Software House	Mail Order	445
•	Arlington Computer Products	Mail Order	554-555
296	B S I	Mail Order	485
•	Bay Express	Mail Order	565
•	Bentley Computers	Mail Order	82-83
•	Boffin Limited	Mail Order	220
481	Bull Dog	Computers & Accessories	460-461
•	Compu Add	Mail Order	350-353
109	Computer Discount Warehouse	Mail Order	557
183	Computer Mailorder	Mail Order	524-525
511	Comtrek Computer	Mail Order	566
105	Datafox	Mail Order	561
250	Dataworld	Mail Order	494
291	DataWorld	Mail Order	338
266	General Technology Corp	Mail Order	484
287	Hub Disk Computer Products	Printer Accessories	226
243	Jade Computer Products	Mail Order	560
346	Jameco Electronics	Mail Order	546
108	JDR Micro Devices	Mail Order	558-559
395	Logicsoft	Mail Order	256-259
387	MHI Warehouse	Mail Order	542
113	Micro Mart, Inc	Mail Order	475
270	Micro-To-Go	Mail Order	468-469
•	MICROBEST	Mail Order	544
200	Microstar	Mail Order	562
524	Moneysworth Computer Products	Mail Order	66-67
527	On Line Store	Mail Order	565
150	PC American	Mail Order	530
310	PC Brand	Mail Order	22-25
•	PC Connection	Mail Order	308-311
202	PC Home	Mail Order	239
535	PC Network	Mail Order	514-517
162	Prism Technologies	Mail Order	553
335	Programmer s Paradise	Mail Order	552
353	Protege	The Protege AT	37
122	QIC Research	QIC 286 System	274
184	Shamrock	Mail Order	550-551
123	Silicon Specialties	Mail Order	87
101	Softhns	Mail Order	84
356	Star Industries	Mail Order	500
209	1elemart	Mail Order	44-45
268	Tussey Computer Products	Mail Order	404-405
380	USA Flex	Mail Order	556
171	Warehouse Data Products	Mail Order	452-453
ON LINE DATA BASES			
226	Compuserve Information Service	On-Line Info Serving	357
•	The Source	The Source	473
UNIX PRODUCTS			
365	A1&1 Information Systems	382	10-11
MISCELLANEOUS			
344	Eastman Kodak	Mass Memory	122

DIRECT MARKETING CONNECTION

•	Arlington Computer Products	Mail Order	554-555
•	Bay Express	Mail Order	565
109	Computer Discount Warehouse	Mail Order	557
511	Comtrek Computers	Mail Order	566
187	Damark International	Mail Order	565
105	Datafox	Mail Order	561
243	Jade Computer Products	Mail Order	560
346	Jameco Electronics	Mail Order	546
108	JDR Micro Devices	Mail Order	558-559
387	MHI Warehouse	Mail Order	542
•	MICROBEST	Mail Order	544
200	Microstar	Mail Order	562
308	National Computer Ribbons	Mail Order	548
234	Northgate Computer Systems	Mail Order	545
240	Northgate Computer Systems	Mail Order	547
247	Northgate Computer Systems	Mail Order	549
527	On Line Store	Mail Order	565
216	Printers Plus	Mail Order	568
162	Prism Technologies	Mail Order	553
335	Programmer s Paradise	Mail Order	552
184	Shamrock	Mail Order	550-551
•	USA Flex	Mail Order	556

MARKETPLACE

185	Accessafile Canada Corp	Accessafile	571
190	Flagstaff Engineering	Tape Backup	572
253	Great Western Electronics	Tandy Computers	570
325	HDG Software, Inc	Legal Ease	568
195	Precision Data Products	Diskettes	572
158	Systems Management Assoc	PC Docu-Rel	569

EDITORIAL PRODUCT INDEX

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
ADD-IN BOARDS			
413	Advantage 2	AST Research Inc	36
414	DuadMeg PS D	Duadram Corp	36
AFTER HOURS			
469	Batalla de Palabras	Gessler Educational Software	606
544	Business Week s Business Advantage	Reality Technology	612
467	Career Navigator	Orake Beam Morrin Inc	606
468	La Guillotine	Gessler Educational Software	606
542	Tinbox2	Derrell Hopper	610
466	Tyler	Matchups	606
543	Where in the USA Is Carmen Sandiego?	Broderbund Software Inc	610
543	Where in the World Is Carmen Sandiego?	Broderbund Software Inc	610
BACKUP			
411	VAST	Emerald Systems Corp	53
COMMUNICATIONS			
410	Data Interrupt Eliminator	Data Spec	52
COMPUTERS			
417	Compaq Deskpro 386 20	Compaq Computer Corp	33
418	Compaq Portable 386	Compaq Computer Corp	35
415	Sharp PC-4501	Sharp Corp	43
CONNECTIVITY			
408	IDEAcomm 5251 MC	IDEAssociates Inc	52
406	IDEAcomm 5250 Remote MC	IDEAssociates Inc	52
DATABASE MANAGEMENT			
398	dBASE III Plus Tips Tricks and Traps	Que Corp	56
GRAPHICS			
405	Snow Partner F X	Brightbill-Roberts Co Ltd	56
HARDWARE			
419	The Extender	Cybex Corp	46
409	PC Guardian Model 1000	Micro Security Devices	53

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
INTEGRATED SOFTWARE			
407	Microsoft Works	Microsoft Corp	53
MONITORS			
412	Amdek Monitor 432	Amdek Corp	52
412	Amdek Monitor 732	Amdek Corp	52
416	Zenith ZCM-1490	Zenith Data Systems	48
PRINTERS			
See Index to Printer Reviews on page 420			
SOFTWARE FONTS			
451	Bitstream Soft Fonts	Hewlett-Packard Co	394
450	Fancy Font	SoftCraft Inc	394
449	Font Control	Polaris Software	394
446	Fontware Installation Kit	Bitstream Inc	394
447	Fontware Library	Bitstream Inc	394
446	Glyphs	SWFTE International Ltd	394
445	Laser Fonts	SoftCraft Inc	394
444	LaserWare	SWFTE International Ltd	394
443	Laser Word Processor Tool Kit	VS Software	394
442	PCLPak	Hewlett Packard Co	395
441	RAM-Resident PrintMerge	Polaris Software	395
440	SoftCraft Fontware Installation Program	SoftCraft Inc	395
439	SoftCraft Standard Series Fonts	SoftCraft Inc	395
438	SoftCraft Typefoundry Series Outline Package	SoftCraft Inc	395
437	Soft Fonts	Hewlett Packard Co	395
436	VS Library of Fonts	VS Software	395
SPREADSHEET ANALYSIS			
400	Excel	Microsoft Corp	33
423	4-5-6 Link	Intex Solutions Inc	52
UTILITIES			
420	Fast Forward	Mark Williams Co	46
422	SoftBytes	Vericomp	53
421	Zoo Keeper	Polaris Software	46
WORD PROCESSING			
399	Dac Easy Word II	Dac Software Inc	43
397	Microsoft Word Version 4 0	Microsoft Corp	36

PRODUCTIVITY

DEPARTMENT	PROGRAM NAME/DESCRIPTION	PAGE
PC Lab Notes	SAFARI makes DOS's Critical Error Handler more helpful and less severe	435
Utilities	CTYPE changes cursor shape and rescues the cursor after exiting programs	463
Environments	Writing programs and converting old DOS programs for the OS/2 Kernel.	483
Spreadsheet Clinic	Leaving 1-2-3's current cell to browse data and return, without macros.	493
Spreadsheet Clinic	DOS batch file reminds you that 1-2-3 is loaded when you exit to DOS.	493
Spreadsheet Clinic	SuperCalc 4's (suspend) macro command temporarily stops macro execution.	493
Spreadsheet Clinic	Routine puts message on-screen telling user that computer is tied up.	494
Spreadsheet Clinic	Technique for sorting multirow entries in 1-2-3 spreadsheets.	494
User-to-User	DRVST reports the status of bytes, clusters, and sectors on any drive.	501
User-to-User	NOBOOT prevents Ctrl-Alt-Del from rebooting a PC.	503
User-to-User	PATHADD.BAT and PATHOLD.BAT temporarily add directories to the PATH	504
Power User	Translating names and phone numbers to spreadsheets using SideKick.	509
Power User	Loading Microsoft Word while giving it a different default directory.	509
Power User	Getting more WordPerfect macros by storing them on different directories.	510
Power User	Always landing on the same field when paging through dBASE records.	513
Power User	WordPerfect transposition macro reverses the order of letters in words	513
Languages	BASIC method for rounding floating-point numbers to given decimal place.	519
Languages	BANNER.BAS is a BASIC program for creating and printing out banners	519
Languages	Re__direction demonstrates Turbo Pascal's I/O redirection technique	520
Languages	STUFFER executes a command or program after a Turbo Pascal program ends	520
PC Tutor	KEYSUB redefines one key to type what a different key types.	527
PC Tutor	DISKLITE blinks a symbol at a corner of the screen during disk accesses.	528
PC Tutor	IBM PC Technical Books and Publications supplies technical book catalog	537
Connectivity Clinic	Explanation of the IBM 3270's CUT and DFT communication modes.	537
Connectivity Clinic	ViaNet and StarLAN, 10-NET, or IBM's PC LAN Program for two-station OBMS	537
Connectivity Clinic	Whether to buy new network-oriented software when installing a new LAN.	537
Connectivity Clinic	RS-232C LAN running EasyLAN easily copies files from one PC to another.	538
Connectivity Clinic	Importance of network's file transfer speed compared with a CPU's or DOS's.	540

COMING UP

MAC II VS. NEW BLUE Apple's new Macintosh II mounts a serious attack on corporate PC users with high-res graphics, built-in hard disk, and full-featured business software including spreadsheets and databases. IBM counters with the PS/2 Model 80, equipped with the state-of-the art 80386 processor and startling new VGA graphics. The two top-of-the-line machines go head-to-head in a cover story that includes reviews by *PC Magazine* columnists Jim Seymour and John C. Dvorak, plus technical specs, features comparisons, and more.

MONOCHROME MARVELS Monochrome monitors are back in style—but this time they're big black-and-white displays whose crisp characters and large screens make them ideal for desktop publishing and CAD. Frank Bican gives you the big picture on paper-white monitors with reviews of offerings from Sigma, Taxan, Wyse, and others.

MULTITASKING WITHOUT OS/2 Until OS/2 is ready, the only benefit you can get from a 386 machine is speed. Or is it? Three operating systems and environments available now, and three more just around the corner, take advantage of the 386 to provide multitasking, multiuser computing with no waiting. Contributing editor Winn L. Rosch reviews OS/2 alternatives from Quarterdeck, Digital Research, and The Software Link, and looks at some intriguing products of the future.

CACHE AS CACHE CAN Disk-caching programs are one of the easiest ways to optimize your PC's performance—they speed up operation by keeping data in special partitions, where it can be grabbed quickly when you need it. Our look at disk caching compares commercial programs with IBM's new caching utility (included with some PS/2 models) to see which product is best.

COPY PROTECTION Always a controversial issue, *PC Magazine* reviews several of the leading copy protection crackers.

INDEX TO ADVERTISERS

RS #	ADVERTISERS	PAGE
169	786 Computer	60-61
273	3M Data Recording Prod Div	455,457
185	Access A File	471
533	Access Micro	526
218	Acer Technologies	318-319
750	ADLIB	509
725	Adobe	100-101
357	AdvancedWare	518
255	Alloy Computer Products	147
242	Alps America	206-207
102	Amdek	448
507	American Micro Tech	2-3
475	American Small Business	482
178	American Software House	448
303	Amstrad	111
117	Ancom America	486
115	Application Techniques	240
327	Applied Creative Technology	47
153	Archive	389
*	Arlington Computer Products	554-555
210	Ashton-Tate	667
*	AST Research	166
*	AST Research	253
385	AT&T Electronic Photography	10-11
194	Autodesk	478
296	B. S. I	485
667	Banner Blue	495
152	Barrington Systems	70
*	Bay Express	565
214	Bay Technical Asc	184
482	Bedford Software	61
*	Bentley Computers	82-83
125	Boffin Ltd	220
377	Borland International	55
166	Borland International	C2-4,1
137	Borland International	57
328	Buffalo Products	196
481	Bulldog Computer Products	460-461
494	Buttonware	316
143	Cadam Inc	327
351	Canon USA	442,443
349	Canon USA	406,409
337	CCDA	491
156	Central Point Software	436
120	Central Point Software	105
221	Charles Well	447
348	CIE Terminals	199
124	CIE Terminals	305
232	Cipher Data Products	523
114	Citizen America	0
112	Citizen America	201
727	C Itoh Digital Products	254
505	Club AT	534-535
188	Command Technology	442
*	Compaq Computer Corp	169-170
*	CompuAdd Corp	350-353
226	Compuserve	357
518	Computer Accessories	227
109	Computer Discount Warehouse	567
183	Computer Mail Order	524-525
511	Comtrek Computers	566
217	Conductor Software	359
213	Consumer s Software Inc	127
225	Core International	183
721	Cosmos	323
360	Crescent Software	522
278	Crosstalk Communications	306
326	Crosstalk Communications	78
248	Cantebury Internti	299
391	Cuesta Systems Corp	466
*	Curtis Mfg	432,434
149	DAC Software, Inc	40-41
187	Damark Int'l	565
375	Data Access	233
146	Data Copy	406
147	Data Copy	477
140/141	DataDesk Int l	321
105	Data Fox	561
258	DataMedia	541
190	DataVue	470
291	Data World	338
250	Data World	494
478	Day-Flo	486
531	DCA	244-245
321	Destiny Technology	411
723	Dialog Information Services	78
241	Diconix	121
280	Digital Products	538
295	Dresselhaus Computer Prod	540
330	Dynamic Microprocessor Assoc	451
166	Eastman Kodak	226
344	Eastman Kodak	122
166	Easy Net	536
*	Ellis Computing	532
*	Epson	105
166	EZX Corporation	4
266	Fifth Generation	128
386	Fivestar Computer	340-341
190	Flagstaff Engineering	573
174	Form Worx	78
246	Fox & Geller	531
297	Front Runner	414
724	Fujitsu America	313
311/315/316	Funk Software	293-296
307	FUTURESOFT	66
324	Gateway Communications	533
266	General Technology	484
506	Generic Software	26
263	Genicom	231
285	Giltronix	314
369	Golden Bow Systems	513
253	Great Western Electronics	570
226	Hauppauge Computer Works	32
201	Haventree	510
166	Hayes	396-667
325	HDG Software	565
280	H&E Computronics	306
142	Hercules	343
509	Hewlett-Packard	159
157	Hewlett-Packard	286
744	Hewlett-Packard	480-481
287	Hub Disk Computer	266
519	IBM Corp	366-367
740	IBM Corp	189
361	Identica	419
389	Indtech Systems Inc	486
361	Information Builders	90
173	Inmax	363
*	Innovative Software	298-301
339	Inset Systems	429
502	InstaPlan Corporation	285
155	Intellicom	480-481
*	Intelligent Microsystems	508-507
*	International Battery Corp	300
376	Iomega	116-117
243	Jade Computer	509
346	Jameco	546
*	Javelin Software	277-282
108	JDR Micro Devices	558-559
272	Kensington Microware	290
244	Key Tronic	99
490	Krieger Data	532
166	Laser Connection	209
178	Laser Connection	521
*	Lifetime Memory Products	236
395	Logicsoft.	286-290
262	Logicsoft	241
182	Logitech	140
133	Logitech	190-191
*	Lotus Development Corp	163, 165
*	Lotus Development Corp	263, 265
*	Lotus Development Corp	564, 565
263	Macola	91
382	Mannesmann Tally	271
154	Math Soft Inc	42
495	Maynard	219
540	MCS Group	451
746	Media Cybernetics	211
*	MICROBEST	544
302	MicroCom Systems	18
388	MicroCom	66
526	Microlytics	371
113	Micro Mart	475
332	Micro Pro Int'l	373-377
292	MicroProse	507
366	Micronm	62-63
*	Microsoft	C5-7
*	Microsoft	C8
*	Microsoft	14-15
200	Microstar	562
390	Microsync	66
735	Microtek	426
270	Micro To Go	468-466
*	Microway Inc	382
384	Migent Software	266
373	Mitsubishi	998
667	MHI Industries	542
524	Moneysworth Computer Products	66-67
363	Mosaic Software	496
*	Motorola	129-130
107	Mountain Computers	196
350	Mouse Systems	144
308	National Computer Ribbons	545
730	Natural Microsystems	499
*	NEC Home Electronics	273
220	Nestar	201
234	Northgate Computer Systems	545
240	Northgate Computer Systems	547
247	Northgate Computer Systems	549
103	Novell Inc	423-425
722	OASYS	157
317	Oakland Group	521
197	Okidata	545
194	Olympia	511
527	On-Line Store	565
492	Orchid Technology	66
159	Paradise Systems	212
661	Pars Systems	347
193	Paul Mace Software	243
150	PC American	530
310	PC Brand	22-66
*	PC Connection	308-311
473	PC Cooling	139
370	PC Designs	313
202	PC Home	230
535	PC Network	514-517
539	PC s Limited	224-266
358	Peachtree Software	348
161	Perma Power	416
385	Persoft	64
178	Personal Computer Products Inc	187
489	Personal Computer Support Group	66
483	Personal Computer Support Group	89-91
282	Personics	15
195	Precision Data Products	572
538	Priam	326
187	Primavera Systems	66
209	Princeton Graphics	390-391
293	Printers Plus	429
216	Printers Plus	565
162	Prism	563
335	Programmer's Paradise	552
353	Protegé	57
526	Public Software Library	21
122	QIC Research	274
181	Quadrum	191
*	Quaid	372
485	Quantum	355
235	Qubie	331
104	Q W Page	441
467	Racal-Vadic	318
729	Ricoh	456
479	Rightsoft	482
290	Rose Electronics	488
392	Saba Technologies	498
739	Salepower Systems	416
316	Samsung	360
470	SBT	20
126	Server Technology	492
184	Shamrock	550-551
252	Sigma Designs	215
123	Silcon Specialties	67
313	SimpleNET	497
314	SimpleNET	498
170	Simon & Schuster	437
726	Softcraft	392
523	Softkions	416
101	Softline	64
266	SoftLogic Solutions	412-413
334	SoftLogic Solutions	203
235	Softronics	407
198	Software Directions	236
354	Software Group	430-431
393	Software Link, Inc	29-31
111	Software Masters	512
*	Software Publishing	143
271	SONY	72
394	Speld Computer Systems	46
129	Standard Microsystems	113
530	Star Industries	482
356	Star Micronics	565
517	STB	364
478	Storage Dimensions/Maxtor.	242
323	Surpass Software	264
118	SWFTE	463
251	Symantec	416
249	Symantec	451
*	Sysgen	328
158	Systems Management Associates	565
135	Tandon Corp	529
289	Tandy/Radio Shack	417
*	Taxan	183
504	Taxan	185
134	TDK Electronics	119
206	Telemart	44-45
*	The Source	473
118	Tipz	540
131	Torrington Company	297
*	Toshiba	337
*	Toshiba	180-181
*	Toshiba	141
*	Toshiba	12-13
231	Touchbase Systems	539
*	Trace Inc	512
*	Transec Systems Inc	66
223	Traveling Software	438
266	Tussey	484-485
233	Unison World	493
380	USA Flex	556
340	Vector	183
364	Ven-Tel Inc	15
127	Video-7	74-75
148	Viewpoint Software	467
171	Wsrehouse Data Products	452-453
515	Wells American	5
503	Western Telematic	217
*	Westlake Data	381
309	WhiteCrane	442
528	Whole Earth	502
222	Worthington	347
516	Xyquest	348
372	Zenith Data	335
108	Zuckerboard-ATD	444
316	Zylab Corp	436

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AFTER HOURS

GAMES

Tyler: A Word Game That Lets You Change The Rules

BY EDWARD MENDELSON

To: After Hours editor
Re: Tyler *review*

I got your message and, yes, I know I'm past my deadline, but I'm so addicted to *Tyler* that I can't break away long enough to review it. Unlike most computer word games, this one (written by Matchups) didn't make me learn a new set of rules. If you know Scrabble, you can play *Tyler*. But you can customize *Tyler* in ways you can't tailor the board game. And that's the fiendish trick it uses to make me keep coming back for more.

Tyler lets me change the rules of the game as well as the size and layout of the board. I racked up a huge score after adding a lot of triple-word squares to the board. Unfortunately, my PC racked up an even bigger score, because *Tyler* is smart enough to plan future moves. I found I could regain the advantages by making the computer show me its moves, or even suggest some moves for me. I was glad to see that it traded in all its pieces every now and then. For a while I thought it was giving itself all the good hands.

I chose the largest of *Tyler*'s 16 vocabulary sizes, with 200,000 words. At this level, the game uses a lot of words I've never seen outside a crossword puzzle. But I can challenge any word I don't like, and I get to decide whether the challenge stands. I decided not to challenge *Tyler* when it played words like *telomic* and *corms* because I had already overruled the challenges it made when I put down *Serbs* and *MSDOS*. After all, it was generous with on-line help and a keyboard template. Fair is fair.



Tyler uses Scrabble's general form but lets you change the rules.

Whenever I needed a break, I played the versions of Jotto and Hangman that came with the disk.

So that's why I haven't written the review. But I promise I'll send it in tomorrow. Or maybe the day after.

List Price: *Tyler*, $50. **Requires:** 192K RAM (512K for the full vocabulary), one disk drive, DOS 2.0 or later. Not copy protected. Matchups, 10 Oak Rd. Medford, MA 02155; (617) 395-4190.

CIRCLE **466** ON READER SERVICE CARD

PERSONAL GROWTH

Charting a New Course In Mid-Career

BY GUS VENDITTO

What color is your parachute? If it's not golden and you're getting close to ground zero, it's time to start thinking about writing a résumé and making discreet phone calls to well-placed friends.

If that thought gives you the willies and your list of contacts is short, you have an alternative to seeking the expensive services of a placement counselor.

Career Navigator is the work of Drake Beam Morin, a high-priced New York City executive counseling service. The agency distilled many of its techniques into this program, which guides you through the creation of a résumé, the focusing of your options, and the mounting of an extensive job search campaign.

A series of easy-to-use menus guides you through tests that use psychological techniques to help you concentrate on jobs appropriate to your skills.

If you're not in the market for a new profession, just a new employer, you can skip over to the brass tacks of a job search. *Career Navigator* will complete your résumé, based on the names, dates, and places you supply to its data questionnaire. But it provides only primitive text-editing features if you want to polish the résumé that the program constructs—the manual will direct you to your own word processor for extensive rewriting.

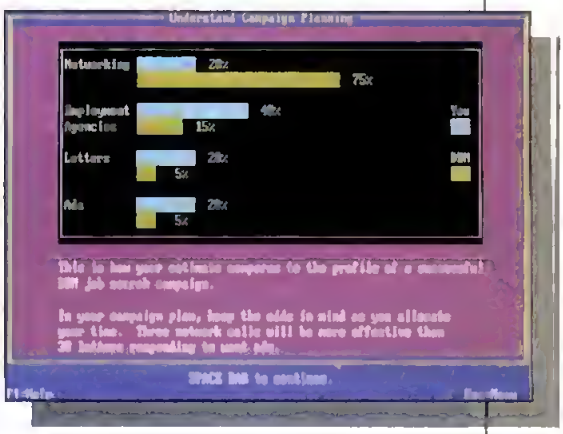
The program's purpose is to hold your hand, patiently explain the right and the wrong way to look for a job, and get on your back if you don't do it right; for instance, if you tell it you've only made one job inquiry this week, it will return polite but firm criticism, reminding you that research shows successful job hunters are aggressive.

The program's usefulness hinges on whether you trust the authors' research and advice; the basic credo is that personal contacts are far more important than want ads and employment agencies. So they keep prodding you to come up with more friends of friends in strategic spots.

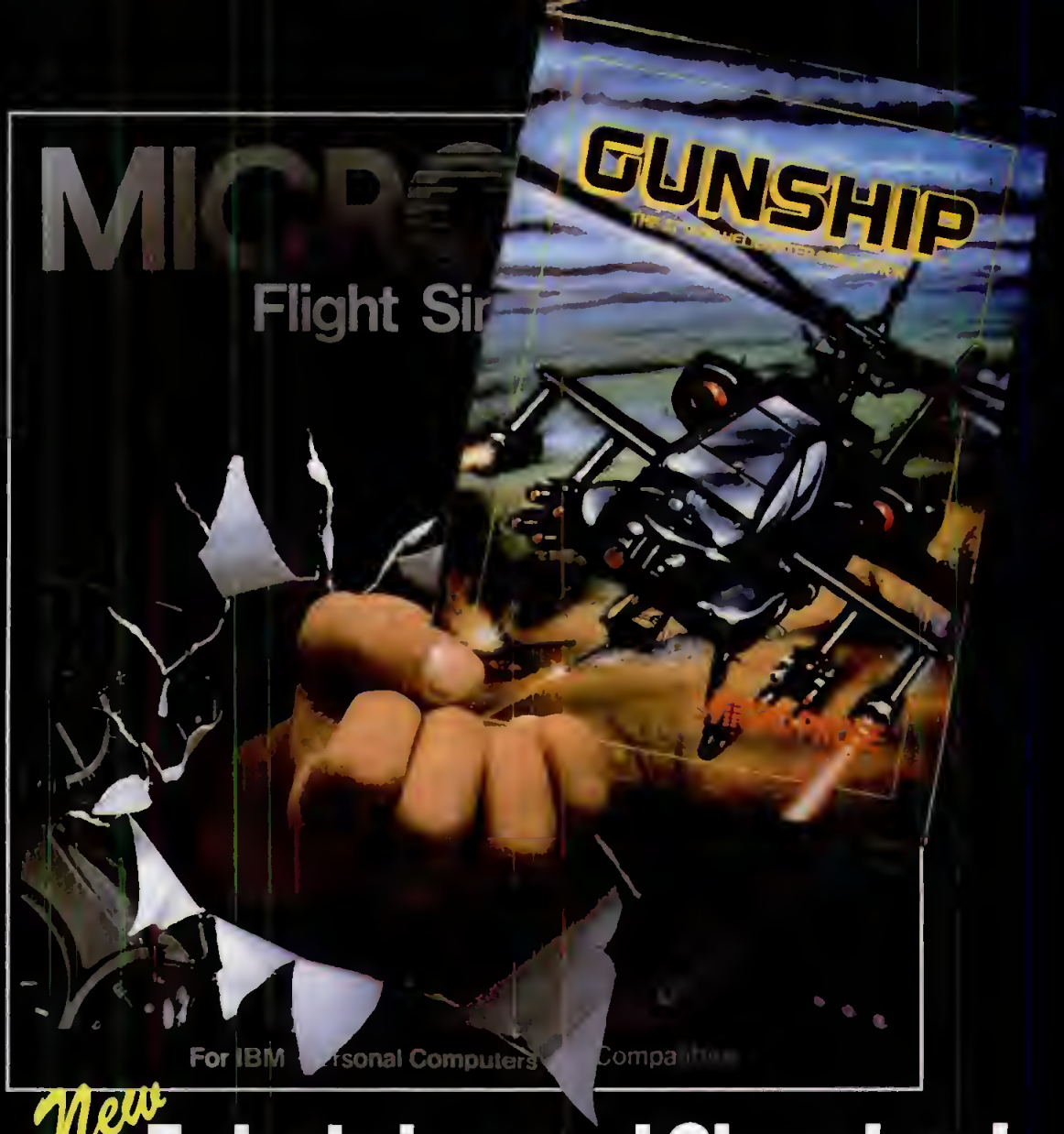
If you're a self-actualized trailblazer with a wide network of professional contacts, you'll find the program's concerned, guidance-counselor approach boring. But if the thought of selling yourself to personnel interviewers makes you clam up, try *Career Navigator*.

List Price: *Career Navigator*, $95. **Requires:** 256K RAM, two disk drives, DOS 2.0, printer. Not copy protected. Drake Beam Morin Inc., 100 Park Ave., New York, NY 10017; (800) 345-JOBS.

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Career Navigator firmly nudges you into being aggressive about job seeking, encouraging you to use friends, relatives, and professional contacts in your search.



The New Entertainment Standard For IBM™- PC's & Compatibles

In the early '80's, IBM computer owners couldn't find any *"fun"* software on the shelves to fill those *"after business"* hours... there just wasn't much out there. Then MicroSoft introduced "Flight Simulator", a great program that's trained a whole generation of armchair computer pilots and set the standard for IBM entertainment software.

But this is 1987... and software buyers with IBM-PC's and compatibles are now looking for a new challenge... searching for excitement... and innovation.

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MicroProse Software presents... **GUNSHIP**... the attack helicopter simulation that sets a new standard of excellence in entertainment software for IBM-PC/compatible software.

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Do you need more realistic flight characteristics? **GUNSHIP** gives you the industry's smoothest animation with a unique dynamic configuration system. The faster your machine operates, the smoother the flight and animation of graphics will be.

Are you tired of just flying around and looking at scenery? In **GUNSHIP**, you pilot an AH-64 Apache helicopter, the modern Army's most lethal weapon, on combat missions that require split-second timing, lightning reflexes and intense concentration. Different skill levels make it easy to learn, but difficult to master.

So if you're tired of sightseeing and want to experience the exhilaration of high-tech combat flight simulation... look for **GUNSHIP**... the new entertainment standard for IBM-PC/XT/AT/PS2 and compatibles (not PC-Jr.).

GUNSHIP supports 320x200-line CGA (4 color), EGA (16 color) or Tandy (16 color) and can be operated using a joystick and/or keyboard controls. The simulation requires 256K of memory and can be installed on a hard disk drive.

GUNSHIP is availeble from a "Valued Micro-Prose Retailer" (VMR) near you. Call us for locations! Suggested retail price $49.95. If product cannot be found locally, call or write for MC/VISA order.



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AFTER HOURS

LANGUAGES

Foreign-Language Tutors that Battle Weak Vocabularies

BY PEGGY GAVAN

Gessler Publishing, renowned in the educational field for supplementary teaching materials, adds fun to language learning with a new lineup of foreign-language software for the PC.

Batalla de Palabras

Leading off this lineup is *Batalla de Palabras* (Word War), a program designed to teach vocabulary, improve reading comprehension, and reinforce syntax for intermediate and advanced students of Spanish. Its sister programs, *Bataille de Mots*, and *Wortgefect*, fight the same war in the French and German languages.

Batalla de Palabras is a learning aid—it will not teach you Spanish. In fact, you must be at least familiar with the basics—grammar, verb conjugations, and common words—to benefit from the program. But if you are studying the language now, looking to brush up on your high school Spanish, or helping your children with their lessons, *Batalla de Palabras* has several features that help take the boredom out of vocabulary drills.

The program's main feature, a vocabulary review, teaches nouns, adjectives, and verbs for the categories of food, sports, travel, school, occupations, and daily life. In this section, you review new words in context in practical, but often complex, sentences.

There is one minor flaw in the vocabulary review section: if you can't translate the Spanish sentences, your frustrations may get the better of you—there's no quick translation at hand. You have to review the sentences and their English equivalents in the self-testing portion of the program.

The testing feature of *Batalla de Palabras* consists of a multiple-choice and a fill-in-the-blank quiz for each category. Optional sound effects ("La Cucaracha" and "The Mexican Hat Dance") signal a correct answer.

Although these quizzes are designed for classroom exercises, you and your children can benefit from them equally at home. They'd provide an excellent forum for family learning.

And if you're like me, and feel elated every time you get the right answer and the screen flashes "Muy bien, Bravo!," you may even have fun.

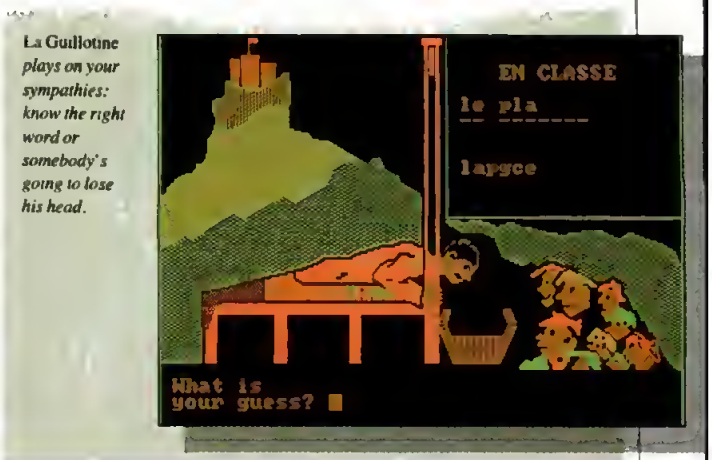
The final section of the program is a simple arcade game complete with graphics and optional sound effects. In this game, you must point and shoot at the correct Spanish word for each given English word. You can choose from slow, medium, or fast speeds.



Space Invaders *inspired* Batalla de Palabras *learning game: you point and shoot at the Spanish word for the English word prompted.*

An added feature of *Batalla de Palabras*—primarily for teachers—is the System Utilities, which allow you to add and delete words or entire categories, and create your own tests for printout.

Learning a new language is a difficult hurdle for anyone. But with *Batalla de Palabras*, the battle is a little bit easier.



La Guillotine *plays on your sympathies: know the right word or somebody's going to lose his head.*

La Guillotine

If you have ever studied a foreign language, or are taking a course now, you know how important it is to build a strong vocabulary. But you also know that memorizing long lists of words is tedious and about as exciting as watching paint dry.

La Guillotine, a French variation of the game of hangman, is a simple BASIC program that teaches and reinforces vocabulary using the classic classroom game.

With *La Guillotine*, you review 40 words in five separate categories—school, the calendar, the home, the restaurant, and occupations—and then challenge the executioner when you feel ready. If you feel you need more practice before risking your head, there is a matching quiz for additional vocabulary review.

In *La Guillotine*, you must save the victim from the executioner's blade by choosing the right letters and guessing the correct word. If you guess correctly, the victim's life is spared; if you guess wrong, or pick too many wrong letters, his head is sliced off. The graphics are simple, so you don't have to worry about it being too violent for children.

The one major problem I had with *La Guillotine* was its brief documentation on installation. The instructions on using the program with a PC were not clear, and it was only after undertaking my own investigation that I got it to work by loading it into BASICA. This is no minor flaw in a game that expects to help children with their language skills.

Otherwise, the program is a good value at $29.95. And although it doesn't make vocabulary drills totally painless, it will make them a little bit more fun.

List Price: *Batalla de Palabras*, $49.95. **Requires:** 256K RAM, one disk drive, DOS 2.0 or later. Not copy protected.

CIRCLE **469** ON READER SERVICE CARD

List Price: *La Guillotine*, $29.95. **Requires:** 64K RAM, one disk drive, DOS 2.0 or later, BASIC. Copy protected. Gessler Educational Software, 900 Broadway, New York, NY 10003; (212) 673-3113.

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Included with the program is Composition Projects™ #1, a step-by-step guide to creating all kinds of music, including classical, jazz, bossa nova, ragtime, and more. Just the thing for an ever-expanding repertoire.

Visual Composer is worth $89.95 if purchased separately, but it's yours free when you buy the system.

Then play back all of your creations, as well as several pre-programmed selections, on the Juke Box™ playback software, also included with your system.

Look for the Ad Lib Personal Computer Music System™ at selected computer and music stores, or order direct from Ad Lib with your check, Visa or MasterCard.

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AFTER HOURS



Where in the USA Is Carmen Sandiego? *throws historical facts at you as it takes you on a chase.*

GAMES

Follow Carmen Sandiego Around the World Without Leaving Town

BY CATHERINE D. MILLER

Have you ever dreamed you were a detective, trailing villains to exciting locations all over the globe? With *Where in the World Is Carmen Sandiego?* you can follow your dreams—for only $44.95.

You start out as a rookie with the Acme Detective Agency. It's 9 A.M. Monday morning and a message comes over the wire from The Chief. One of Carmen Sandiego's V.I.L.E. (Villain's International League of Evil) henchmen is thought to be responsible for the theft of a national treasure from one of 30 cities where V.I.L.E. has operational bases. You are assigned the case and have until 5 P.M. Sunday to solve it.

You begin your investigation in the city where the theft took place. You get clues about the thief and her next destination by asking around. You might find your informants at the library, bank, or museum.

Once you have enough information about the thief, use Interpol's Crime Computer to get an arrest warrant. If you don't have an arrest warrant or take too long to catch the thief, Carmen's gang will pull off another caper.

As you trail the thief, the *1987 World Almanac* and a map of V.I.L.E. operational bases included with the program help you decipher the clues. A V.I.L.E. henchman will appear on your screen to let you know you have traveled to the right place. As you successfully solve cases, you are promoted through the ranks.

Where in the USA Is Carmen Sandiego? sharpens your detective skills as you trail Carmen's new gang all over the United States and expands your knowledge of history and geography. The *Fodor's USA* travel guide is included with this program at no extra charge to keep you on the right track.

Where in the World and *Where in the USA* are completely menu driven, so it's easy to make your choices. And the animated graphics make your travels enjoyable.

But the nicest thing about these programs is how much you learn about the cities of the United States and the world, by trying to trail the members of Carmen's gang. You learn about the geography, the history, and the culture of these places, and that always keeps the chase interesting.

Because these programs are powerful learning tools, they're very popular in schools. But it is not possible to exit either program without rebooting. And that's no way to learn how to use a computer.

List Price: *Where in the World Is Carmen Sandiego?* and *Where in the USA Is Carmen Sandiego?*, $44.95 each. **Requires:** EGA, CGA, or Hercules graphics. DOS 2.0 or later. Copy protected. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903; (415) 479-1170.

CIRCLE **543** ON READER SERVICE CARD

PERSONAL FINANCE

A Down-home Database for a Household Inventory

BY EDWARD MENDELSON

What will you do when lightning strikes your power mower? Does your home insurance cover your meat grinder? Will you be covered if a burglar takes the decorator magnets off the refrigerator door? Can you afford to replace your bow and arrows?

These are a few of the urgent questions raised by *Tinbox2*, the home-inventory database by Derrell Hooper. If you ever need to rebuild and restock your home after fire, theft, flood, or tornado, your insurance company will want a full list of your lost possessions with the value of each.

You can use any database program to compile such a list, but what if you don't have a copy of *dBASE* at home? *Tinbox2* is designed to let you compile a household inventory with price and serial number for each item and costs the amazingly low price of $20.

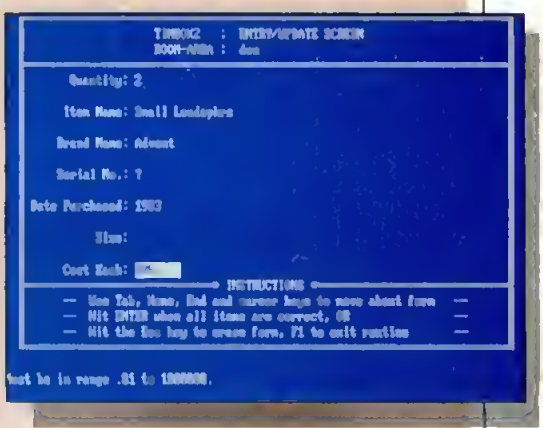
Every room in the house gets a separate file with a name like KITCHEN.TIN. When you finish entering the complete list, the program reports the total of the prices. If your insurance doesn't cover that sum, it's time to call your agent.

If you have an Epson-compatible printer, *Tinbox2* will give you a 19-page sample checklist that you can use as a starting point. It's an enormous list of everything that you are likely to find around the house, and it includes bows and arrows, the meat grinder, the shampoo in the bathroom, and just about anything else. With this list as a reminder, you won't forget the decorator magnet on the refrigerator door, either.

List Price: *Tinbox2*, $20. **Requires:** 192K RAM, Epson-compatible printer for printout. Not copy protected. Derrell Hooper, P.O. Box 1461, Keene, NH 03431.

CIRCLE **542** ON READER SERVICE CARD

Tinbox2*'s main value is encouraging you to think about, and record, the vital statistics on all of your possessions.*



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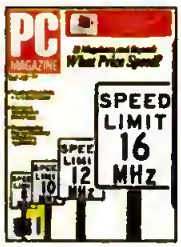
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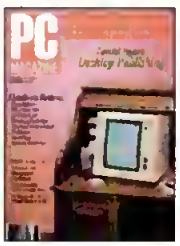
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PERSONAL GROWTH

Business Advantage: Fun with Somebody Else's Bottom Line

BY MERV ADRIAN
AND STEPHEN LEVIN

Business majors often look back at one class they took in their last undergraduate semester with great fondness—the "business game" course, where management theories are applied to a simulated problem. That technique has been used on the PC for years, but never with as much flair as in *Business Week's Business Advantage*.

You start by loading a scenario of facts and figures drawn from an actual story published in *Business Week*. You have a choice of two: Chrysler's battle to hold onto its newly won market share or Compaq's struggle against a surge of clone makers. The basic engine of the product is a mini expert system; also included are an integrated spreadsheet/modeling tool, graphics, and reporting capabilities, and a glossy reprint of *Business Week*'s original article. For $249 you can get a subscription of monthly articles for a year, culled from future issues of *Business Week*.

After loading the article, you read it to learn the company's recent history and its long-range strategy. A feature story is included, plus a series of relevant statistics: company reports (balance sheets and income statements); industry statistics and trends; information on your competitors; environmental data (prices and interest rates); and so on.

You can call in a "consultant" to explain terminology or the significance of events.

You'll find most of the pertinent data a sophisticated analyst would want, presented in ways similar to those used by senior executives. You have to deal with the weaknesses as well as the strengths of those presentations. For example, production statistics (including costs) are presented separately from marketing information (such as margins and sales trends). You have to relate these two sets of data yourself to make effective decisions, just as an executive does.

Which brings to light the package's biggest weakness: There's no coherent methodology to help you understand the relationships between the numbers or to guide you in making decisions. You may find yourself floundering, wondering, "What was that number on the balance sheet and what did it mean?" Use the built-in print capabilities and do a lot of screen dumps—it helps.

When you've made all of your decisions, select Process, and the system calculates the impact of your decisions based on its rule system. If return on investment goes down, ask why. You'll be told that net profit went up less than fixed costs and that N.O.I. . . . well, we don't want to spoil the fun.

Business Advantage will not help you learn how to create a 10-year strategic plan. This is medium-term stuff, paced for about a 1-year lead time. Nor will it help for very short-term planning—after all, you can't plan day by day until your annual business game plan is in place. Still, this is truly a remarkable and worthwhile product, and we recommend it highly to anyone with an interest in business management.

List Price: *Business Week's Business Advantage*, $49; 12 additional case studies, $249.

Requires: 384K RAM, two disk drives, DOS 2.0 or later. Not copy protected. Reality Technology, 3624 Market St., Philadelphia, PA 19104; (800) 346-2024.

CIRCLE 544 ON READER SERVICE CARD



Business Advantage's finely tuned presentation lets you call on charts, spreadsheets, and dictionaries in making your management decisions

AFTER HOURS INDEX

Business Week's Business Advantage
A management simulation
Where in the World Is Carmen Sandiego? and **Where in the USA Is Carmen Sandiego?**
Mystery, intrigue, geography
Tinbox2
Inventory your assets for only $20
Battalla de Palabras and **Le Guillotine**
Foreign-language games
Tyler
Play Scrabble by your own rules
Career Navigator
Chart a new course

Consulting Business Advantage's Expert

The simulated win-lose situations in *Business Advantage* are tracked by a 400-rule expert system or knowledge network.

This network maps all relationships among variables in the simulation. Since the program gives you a choice of two objectives—maximize return on assets or increase market share—which you carry out by a series of decisions, it's up to the expert system to sit in judgment of your performance.

One of *Business Advantage*'s greatest benefits is that it lets you look at the network's decision tree, so you can see where your marketing savvy soured, if it did.

Even the newest, fastest, cleverest machines lack one minor feature.

A soul.

IT'S A WHOLE NEW ANIMAL.



The new Microsoft® Mouse.

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